UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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MEMORANDUM

Subject: Registration Review: Problem Formulation for Ecological Risk, Environmental Fate, Endangered Species, and Drinking Water Assessments for Trichlorfon

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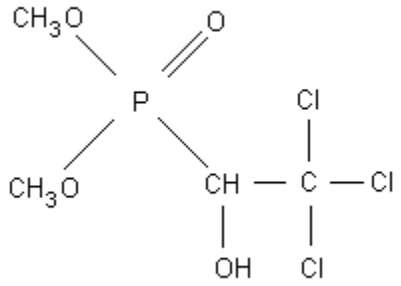
The Environmental Fate and Effects Division (EFED) has completed the problem formulation (attached) for the ecological risk, environmental fate, endangered species, and drinking water assessments to be conducted as part of the Registration Review of the organophosphate insecticide, trichlorfon (PC Code 057901). Functioning as the first stage of the risk assessment process for registration review, this problem formulation provides an overview of what is currently known about the environmental fate and ecological effects associated with trichlorfon and its degradates. It also describes the preliminary ecological risk hypothesis and analysis plan for evaluating and characterizing risk to non-target species and the environment in support of the registration of trichlorfon.

Office of Prevention, Pesticides,
and Toxic Substances

Problem Formulation for the Environmental Fate, Ecological Risk, Endangered Species, and Drinking Water Assessments in Support of the Registration Review of Trichlorfon



dimethyl2,2,2-trichloro-1-hydroxyethyl-phosphonate (CAS 52-68-6)

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1. Purpose

The purpose of this problem formulation is to provide an understanding of what is known about the environmental fate and ecological effects of the registered uses of trichlorfon. Trichlorfon is an organophosphate used as an insecticide on golf course turf, home lawns, ornamentals (flowers, trees and shrubs), and ponds (ornamental and bait fish and non-food aquatic plants). This document will provide a plan for analyzing data relevant to trichlorfon, and for conducting environmental fate, ecological risk, endangered species and drinking water assessments for registered trichlorfon uses. Additionally, this problem formulation is intended to identify data gaps, uncertainties, and potential assumptions used to address those uncertainties relative to characterizing the ecological risk associated with the registered uses of trichlorfon.

2. Problem Formulation

2.1. Nature of Regulatory Action

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), all pesticides distributed or sold in the United States generally must be registered by EPA. In determining whether a pesticide can be registered in the U.S., EPA evaluates its safety to non-target species based on a wide range of environmental and health effects studies. In 1996, FIFRA was amended by the Food Quality Protection Act, and EPA was mandated to implement a new program for the periodic review of pesticides, *i.e.*, registration review (http://www.epa.gov/oppsrrd1/registration_review/). The registration review program is intended to ensure that, as the ability to assess risk evolves and as policies and practices change, all registered pesticides continue to meet the statutory standard of no unreasonable adverse effects to human health and the environment. Changes in science, public policy, and pesticide use practices will occur over time. Through the new registration review program, the Agency periodically reevaluates pesticides to make sure that as change occurs, products in the marketplace can be used safely.

As part of the implementation of the new Registration Review program pursuant to Section 3(g) of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the Agency is beginning its evaluation of trichlorfon to determine whether it continues to meet the FIFRA standard for registration. This problem formulation for the environmental fate, ecological risk, endangered species, and drinking water assessment chapter in support of the registration review will be posted in the initial docket opening the public phase of the review process.

2.2. Previous Risk Assessments

A national-level ecological risk assessment was completed as part of the reregistration eligibility decision (RED) for trichlorfon in January 1997 (USEPA 1997). The Environmental Fate and Effects Division's (EFED) science chapter for the RED, which incorporated new data, was revised in 2000 (USEPA 2000). An interim Tolerance Reassessment and Risk Management Decision (TRED) for trichlorfon was conducted in

2001 (USEPA 2001). The TRED was finalized in July 2006 after the cumulative human health risk assessment of the organophosphate (OP) class of pesticides was completed (USEPA 2006b).

A drinking water assessment was conducted for the TRED. In this assessment, it was concluded that drinking water risk estimates for surface and ground waters did not exceed levels of concern, except for children aged 1-6 obtaining drinking water from surface water sources (USEPA 2006b).

The ecological risk assessment included in the trichlorfon RED was based on laboratory fate and ecotoxicological data submitted by the registrant in support of reregistration and from data in publicly available literature, and incident reports of adverse effects on non-target organisms associated with the use of trichlorfon. The previous ecological risk assessments considered the parent chemical only (*i.e.*, the degradates of toxicological concern were not considered). The primary environmental concerns identified in the 1997 and 2000 environmental fate and ecological risk assessments were acute and chronic risks to birds, mammals, fish, and aquatic invertebrates (USEPA 1997, 2000).

Based on the results of the TRED, a number of mitigation measures were recommended to address risks to handlers and workers. These risk mitigation measures included the following: prohibit broadcast treatment to golf course fairways (permit spot treatment to fairways); require a 7-day application interval for application to turf and limit applications to no more than 3 per calendar year; require applicators to use a truck-drawn spray rig for application to fish ponds over 1 acre; and prohibit foliar applications to ornamentals (allow only direct soil spray to base of the plant). These mitigation measures appear on some, but not all, of the current trichlorfon labels (see Section 3.2).

An emergency exemption petition (Section 18) ecological risk assessment for use of trichlorfon on ornamentals (in Kansas) was also completed by EFED (1996). The results of the Section 18 assessment indicated that the proposed use of trichlorfon on ornamentals in Kansas would not result in risks to non-target organisms.

EPA reinitiated a formal consultation with the U. S. Fish and Wildlife Service (USFWS) in 1989 regarding trichlorfon impacts on endangered species. This consultation was on selected portions of five previous "cluster" biological opinions evaluating pesticides for certain crops (corn, cotton, soybeans, sorghum, wheat, barley, oats and rye), forestry use pesticides, mosquito larvicides, and rangeland and pastureland pesticides. As a result, the USFWS issued a formal Biological Opinion (USFWS 1989). The opinion identified 79 aquatic species (6 amphibians, 41 fish, 6 aquatic invertebrates, and 25 mussels) and one terrestrial species (a bird) that were classified as "in jeopardy" from trichlorfon use.

3. Stressor Source and Distribution

Trichlorfon degrades to dichlorvos (DDVP), which is also a pesticide active ingredient (PC Code: 084001). DDVP is a registered pesticide used as an insecticide applied to greenhouses, mushroom houses, residential areas, and premise treatments in agricultural

areas (e.g. barns and sheds) (USEPA 2006a). Unlike in previous ecological assessments conducted by the Agency for trichlorfon, the major degradate DDVP will be considered in the ecological risk assessment conducted as part of the Registration Review process. The assessment for registration review will estimate risk from exposure to trichlorfon, and its degradate DDVP by evaluating "total trichlorfon residues of concern" (trichlorfon plus DDVP).

Although DDVP is a major degradate of trichlorfon, ecological and endangered species assessments for the trichlorfon registration review will not evaluate the usage or impact of DDVP as a primary active ingredient or as a degradate of other pesticide products. While DDVP may potentially be used simultaneously (for different purposes) within the same areas as trichlorfon, the use of DDVP will not be addressed in the ecological and endangered species risk assessments for the trichlorfon registration review. However, the upcoming drinking water assessment for the trichlorfon registration review will consider all sources of DDVP, including direct applications of DDVP as a pesticide active ingredient, as well as uses of trichlorfon and naled (PC code: 034401), which both degrade to DDVP.

3.1. Mechanism of Action

Trichlorfon, dimethyl 2,2,2-trichloro-1-hydroxyethyl-phosphonate, is an insecticide belonging to the organophosphate class of pesticides. Organophosphate toxicity is based on the inhibition of the enzyme acetylcholinesterase, which cleaves the neurotransmitter acetylcholine. Inhibition of acetylcholinesterase by organophosphate insecticides interferes with proper neurotransmission in cholinergic neurosynapses and neuromuscular junctions. The trichlorfon degradate DDVP has a similar mode of action.

3.2. Overview of Pesticide Use and Usage

Trichlorfon was originally registered for use in the United States in 1955. Currently, labeled uses of trichlorfon include turfgrass (golf courses, recreational turf and residential turf), flowers, shrubs, trees, and ponds (those that contain bait and/or ornamental fish and/or non-food aquatic plants). There are both commercial and residential uses. There are currently nine active Section 3 and three Special Local Needs labels for products containing trichlorfon (
Table 1). There are both granular and flowable uses. According to the product labels, trichlorfon can be applied by aerial or ground equipment. Currently there is only one label that allows for aerial applications (Dylox 80 SP, EPA reg. no.: 432-1326); all other labels limit applications to ground equipment. The maximum single application rate for trichlorfon is 8.15 lb a.i./acre. None of the current labels specify a maximum number of applications allowed per year. Some labels specify a minimum 7-day application interval and a maximum yearly application rate of 24.5 lb a.i./acre (
Table 1). The remaining labels do not specify a minimum application interval or a maximum yearly application rate.

At this time, no national level use data have been identified for trichlorfon. Pesticide use information from the California Department of Pesticide Regulation (CDPR 2007), include county-level data for various trichlorfon uses from 2001-2003. Past uses of trichlorfon in California include: landscape maintenance, greenhouse, and water areas.

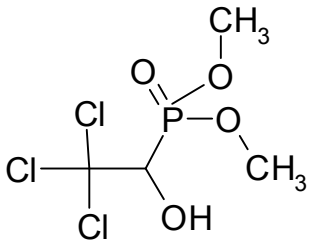
Table 1. Summary of Current Trichlorfon Labels.

PRODUCT (% a.i.)/ EPA REG. NO.	USES	APPL. METHOD(S)	MAX. SINGLE APPL. RATE	MAX YEARLY APPL. RATE/NO. OF APPL.	APPL. INTERVAL	RESTRICTIONS
Dylox 80 Concentrate (80%)/432-1289	For formulation into end use products	N/A	N/A	N/A	N/A	Only for formulations into end-use products on lawns, turf and recreation areas
Dylox 80 SP (80%)/432-1326	Flowers, shrubs, and trees and recreational lawns and turf	Ground Aerial	8.15 lb a.i./acre *Narcissus* - 16 oz a.i./1,000 feet of row	For *Narcissus* – 1/year All other use - Not specified	Not specified	- Do not apply directly to water.
Dylox 80 Turf and Ornamental (80%)/432-1289	Landscape flowers, shrubs, trees, and landscape and recreational turf	Ground	8.15 lb a.i./acre *Narcissus* - 16 oz a.i./1,000 feet of row (repeat treatments annually)	24.5 lb a.i./acre No. of Applications Not Specified	7 days	- Do not apply directly to water. - Do not apply when average wind speeds are greater than 15 mph - Apply product using spray nozzles which produce a coarse droplet size - Do not apply within 25 ft of lakes, reservoirs, rivers, permanent streams, marshes, natural ponds, or estuaries. - Do not apply through any type of chemigation system - Golf courses: broadcast use is limited to tees and greens; use on fairways is limited to spot treatments
Dylox 420 SL (37.3%)/432-1464	Landscape flowers, shrubs, trees, and landscape and recreational turf; golf course and residential turf	Ground	7 lb a.i./acre *Narcissus* – 13.8 oz a.i./1,000 feet of row	24.5 lb a.i./acre For *Narcissus* – 1 application/ year All other use – No. of applications not specified	7 days	
Dylox 80 (80%)/ FL03001200 (432-1289)	Commercially-operated aquaculture production systems containing ornamental fish or non-food aquatic plants	Hand-held sprayer (systems less than 1 acre) Truck-drawn sprayer (systems greater than 1 acre)	0.25 mg a.i./L	Not specified	14-days	None
Dylox 80 (80%)/ AR98000300 (432-1289)	Commercially-operated ponds used for bait fish and ornamental fish production aquatic plants	Not specified (limited to ground equipment on Federal label)	0.25 mg a.i./L	Not specified	Not specified (7-day interval on Federal label)	None
Dylox 80 (80%)/ MO99000500 (432-1289)						
Dylox 6.2	Turfgrass	Ground	8.10 lb a.i./acre	24.5 lb	7 days	- Do not apply directly

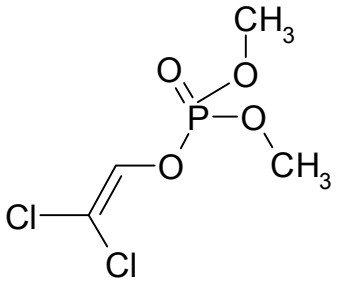
PRODUCT (% a.i.)/ EPA REG. NO.	USES	APPL. METHOD(S)	MAX. SINGLE APPL. RATE	MAX YEARLY APPL. RATE/NO. OF APPL.	APPL. INTERVAL	RESTRICTIONS
Granular (6.2% trichlorfon)/432-1308 (Bayer Environmental Science) **Granular**				a.i./acre Max. no. of applications not secified		to water - Golf courses: do not apply within 25 ft of lakes, reservoirs, rivers, permanent streams, marshes, natural ponds, or estuaries - Not for use on turf being grown for sale - Must be watered in after application to move product into root zone - Golf courses: broadcast use is limited to tees and greens; use on fairways is limited to spot treatments
The Andersons Tee Time Insecticide with 6.2% Dylox (6.2% trichlorfon)/9198-110 (the Andersons Lawn Fertilizer Division) **Granular**						
Dylox Grub Control (6.2%)/432-1394 **Granular**	Lawns	Ground	8.10 lb a.i./acre	Not specified	Not specified	- Do not apply directly to water - Do not apply near fish pools, ponds, streams or lakes - Water thoroughly within 24 hrs after applying
Dylox 9.3% Insect Granules (9.3%)/72155-83 **Granular**	Lawns (residential use only)					
Dylox Insect Granules (6.2%)/72155-33 **Granular**						

3.3. Environmental Fate and Transport

The chemical structures of trichlorfon and DDVP are depicted in Figure 1. Registrant-submitted data defining the physical, chemical, fate and transport characteristics associated with trichlorfon are summarized in Table 2. As part of registration review, available fate studies for trichlorfon have been reevaluated by EPA. The fate and transport of trichlorfon in the environment is briefly discussed below.



Trichlorfon



DDVP

Figure 1. Structures of trichlorfon and DDVP.

Table 2. General Chemical and Environmental Fate Properties of Trichlorfon and DDVP.

Chemical/Fate Property	Trichlorfon Value (source)	DDVP Value (source)
Molecular Weight (MW; g/mol)	**257.4** (MRID 00152133)	**221.0** (USEPA 2006a)
Water Solubility (Sol; mg/L; at 25 °C)	**$1.36x10^5$** (MRID 00152133)	**$0.15\ x10^5$** (USEPA 2006a)
Vapor Pressure (VP; torr; at 25°C)	**$3.75\text{-}4.5x10^{-6}$** (MRID 41535301, 41535302)	**$1.2x10^{-2}$ (@20°C)** (USEPA 2006a)
Henry's Law Constant (H;atm-m^3/mol)	**$8.20\text{-}9.84\ x10^{-11}$** (*)	**$2.75\ x10^{-6}$** (*)
Octanol-water Partition Coefficient (Log K_{OW})	**0.30** (MRID 00162307)	**1.58** (MRID 40798103)
Octanol-air Partition Coefficient (Log K_{OA})	**9.7** (**)	**6.1** (**)
Organic carbon normalized partition coefficient (L/kg; K_{OC})	**58.8*** (EPISUITE v. 3.20)	**37** (MRID 41354105)
Hydrolysis half lives (days)	**No data available**	**pH 5: 11.6** **pH 7: 5.2** **pH 9: 0.88** (MRID 41723101)
Aqueous photolysis half-life (days)	**Stable** (MRID 00148975)	**10** (MRID 43326601)
Soil Photolysis half-life (days with 12 h light/12 h dark)	**No data available**	**0.65** (MRID 43642501)
Aerobic Soil Metabolism half-life (days)	**6.4** (MRID 42243601)	**0.42** (MRID 41723102)
Anaerobic Soil Metabolism half-life (days)	**1.8** (MRID 42243601)	**6.2** (MRID 43835701)
Aerobic Aquatic Metabolism half-life (days)	**No data available**	**No data available**
Anaerobic Aquatic Metabolism half-life (days)	**No data available**	**4.5** (MRIDs 40618201, 41354102, 42445101)

*Estimated according to: $H = \frac{VP * 760}{Sol * MW}$ $(USEPA\ 2002)$

**Estimated using Episuite v. 3.20.

3.3.1. Degradation

No scientifically valid studies are available to describe the degradation of trichlorfon by hydrolysis. Degradation of DDVP by hydrolysis is pH dependant. In a hydrolysis study, DDVP half-lives decreased with increasing pH, with observed half-lives of 11.6 days, 5.2 days, and 0.88 days, at pH 5, 7 and 9, respectively (MRID 41723101).

In a supplemental aqueous photolysis study, trichlorfon was stable to photolysis (MRID 00148975). Available aqueous and soil photolysis studies indicate that DDVP is more susceptible to photodegradation than trichlorfon, with half-lives of 10 and 0.65 days, respectively (MRIDs 43326601 and 43642501).

In an acceptable aerobic soil metabolism study, trichlorfon had a half-life of 6.4 days on a sandy loam soil. During this study, 3 major degradates were observed: dichloroacetic acid (DCA) and 1-hydroxy-2,2-dichlorovinyl phosphate (HDCP) and carbon dioxide. DDVP was not detected as a degradate in this study (MRID 42243601). In an aerobic soil metabolism study, DDVP had a half-life of 0.42 days (MRID 41723102).

In an acceptable anaerobic soil metabolism study conducted with the same sandy loam soil, trichlorfon had a half-life of 1.8 days. Major degradates observed during this study included: DCA, HDCP, carbon dioxide and glyoxylic acid (GA). DDVP was observed as a minor degradate (MRID 42243601). In an anaerobic soil metabolism study, DDVP had a half-life of 6.2 days (MRID 43835701).

3.3.2. Transport

No scientifically valid studies are available to define the mobility of trichlorfon in soil. The estimated organic carbon partition coefficient (K_{oc}) of 58.8 (EPIsuite, v.3.20) suggests that trichlorfon may be mobile in soil. Based on the results of an acceptable soil TLC study, DDVP is also mobile, with a K_{oc} of 37 L/kg (MRID 41354105).

Consideration of the vapor pressure ($3.75\text{-}4.5 \times 10^{-6}$ torr; MRIDs 41535301, 41535302) and Henry's Law constant ($8.20\text{-}9.84 \times 10^{-11}$ atm-m^3/mol) of trichlorfon indicates that it is unlikely to be transported significantly into the air through volatilization from the treatment site. In contrast, the vapor pressure (1.58×10^{-2} torr; EPIsuite v.3.20) and Henry's Law constant (3.62×10^{-7} atm-m^3/mol) of DDVP are several orders of magnitude higher than those of trichlorfon, suggesting that DDVP may volatilize when it has been formed from trichlorfon.

In a laboratory volatility study, 84% of trichlorfon residues remained on the soil to which it was applied 14 days previously. Volatilized residues comprised 14% of the total applied, and were identified as carbon dioxide. Trichlorfon and DDVP were not identified as volatilized residues (MRID 40279302).

3.3.3. Terrestrial Field Dissipation

Two supplemental terrestrial field dissipation studies are available where trichlorfon was applied to sandy loam soil and to turf in field lysimeters contained in Ontario and Missouri (MRIDs 47519201 and 45895501, respectively). In the bare soil treatments of both studies, the majority of the applied residues were detected in the upper 0-6 inches of the test soil, with a half life of 3.1 days in the Ontario test and 1.9 days in the Missouri test. Carbon dioxide was detected as a major degradate in the Ontario test and a minor degradate in the Missouri studies. In both studies, DCA was detected as a major degradate. DDVP was detected as a minor degradate in the Ontario study, but undetected in the Missouri study. The maximum residues detected in the leachate comprised <0.2% of the applied.

3.3.4. Bioaccumulation

The octanol-water partition coefficients of trichlorfon (Log K_{OW} = 0.30; MRID 00162307) and DDVP (Estimated Log K_{OW} = 0.60; EPIsuite, v.3.20) indicate that trichlorfon and DDVP are not expected to bioaccumulate in aquatic ecosystems.

The estimated Log octanol-air partition coefficients (Log K_{OA}) for trichlorfon and DDVP (9.7 and 6.1, respectively; EPIsuite, v.3.20) in combination with their Log K_{OW} suggest that biomagnification of trichlorfon and DDVP in terrestrial food chains is unlikely (Kelly *et al*. 2007). In addition, biomagnification in terrestrial food chains may be limited by transformation of trichlorfon and DDVP to less toxic degradates.

4. Receptors

Consistent with the process described in the Overview Document (USEPA 2004), the risk assessment for trichlorfon relies on a surrogate species approach. Toxicological data generated from surrogate test species, which are intended to be representative of broad taxonomic groups, are used to extrapolate to potential effects on a variety of species (receptors) included under these taxonomic groupings.

Because the trichlorfon degradate DDVP is also a registered pesticide (PC Code: 084001), data are available to define the toxicity of this degradate of concern to non-target organisms. To adequately capture the risk from trichlorfon use, the toxicity and potential exposure to non-target animals to trichlorfon and its degradate DDVP will be considered. The most sensitive endpoints from the available toxicity data for trichlorfon and DDVP will be used to quantify risk.

Acute and chronic toxicity data from studies submitted by pesticide registrants along with the available open literature are used to evaluate the potential direct and indirect effects of trichlorfon to aquatic and terrestrial receptors. This includes toxicity on the technical grade active ingredient, degradates, and when available, formulated products (*e.g.*, "Six-Pack" studies). The open literature studies are identified through EPA's

ECOTOXicology (ECOTOX) database (USEPA 2007*a*), which employs a literature search engine for locating chemical toxicity data for aquatic life, terrestrial plants, and wildlife. The evaluation of both sources of data may also provide insight into the direct and indirect effects of trichlorfon and its degradate DDVP on biotic communities from loss of species that are sensitive to the chemical and from changes in structure and functional characteristics of the affected communities. Open literature data from ECOTOX on trichlorfon are not currently available; however, once received, they will be evaluated for possible quantitative and/or qualitative inclusion in this risk assessment.

A summary of the most sensitive data representing non-target organisms exposed to trichlorfon and DDVP in aquatic and terrestrial habitats is provided in Sections 4.1 and 4.2, respectively. A summary of ecological incidents associated with trichlorfon and DDVP and a description of ecosystems potentially at risk are provided in Sections 4.3 and 4.4, respectively.

4.1. Effects to Aquatic Organisms

Trichlorfon is classified as very highly toxic to freshwater invertebrates, highly toxic to freshwater fish, and practically nontoxic to estuarine/marine invertebrates (Eastern oysters) on an acute exposure basis. No acceptable acute data for trichlorfon are available for estuarine/marine fish. DDVP is classified as very highly toxic to freshwater and estuarine/marine invertebrates, highly toxic to freshwater fish, and moderately toxic to estuarine/marine fish on an acute exposure basis (Table 3). No acceptable aquatic plant toxicity data are currently available for trichlorfon or DDVP. Summaries of the most sensitive acute aquatic toxicity data available from registrant-submitted studies for trichlorfon and DDVP are provided in Table 4 and in Table 5**,** respectively. Additional information on the ecotoxicity data currently available for trichlorfon and DDVP are provided in **APPENDIX A**.

Table 3. Classifications of acute toxicities of trichlorfon and DDVP to aquatic animals.

TAXON	Trichlorfon	DDVP
Freshwater Invertebrate	Very highly toxic[1]	Very highly toxic[1]
Freshwater Fish	Highly toxic[2]	Highly toxic[2]
Marine/Estuarine Invertebrate	Practically non-toxic[4]	Very highly toxic[1]
Marine/Estuarine Fish	No data	Moderately toxic[3]

[1] LC_{50}<0.1 mg/L
[2] LC_{50} 0.1 - 1.0 mg/L
[3] LC_{50} >1.0 - 10 mg/L
[4] LC_{50}>100 mg/L

For trichlorfon, chronic effects in aquatic animals include diminished survival (freshwater and estuarine/marine invertebrates), reproduction (freshwater fish and estuarine/marine invertebrates), and growth (estuarine/marine invertebrate). No acute or chronic data are available for estuarine/marine fish for trichlorfon. For DDVP, chronic effects in aquatic animals include diminished survival (freshwater and estuarine/marine fish), reproduction (freshwater invertebrates), and growth (freshwater and estuarine/marine invertebrates and estuarine/marine fish). Summaries of the most

sensitive chronic aquatic toxicity data available from registrant-submitted studies for trichlorfon and DDVP are provided in Table 4 and in Table 5, respectively.

Based on currently available data, DDVP appears to be more or equally as toxic to aquatic animals when compared to trichlorfon on both an acute and chronic exposure basis.

Table 4. Summary of Submitted Studies for Aquatic Organisms Exposed to Technical Trichlorfon (Most Sensitive Endpoints for Each Taxon).

TAXON & SPECIES	ENDPOINT	MRID	STUDY CLASS-IFICATION	COMMENTS
Freshwater Invertebrate (Acute) *Pteronarcella badia*	EC_{50} (96-hr) = 5.3 µg a.i./L	40098001	Supplemental	Adequate for RQ calculation; based on analysis of raw data, the slope is 5.2 (C.I.: 2.6 – 7.9)
Freshwater Invertebrate (Chronic) *Daphnia magna*	NOAEC = 0.0057 µg a.i./L	40452601	Acceptable	LOAEC (0.0086 µg a.i./L) based on survival (all endpoints were affected in the study, the most sensitive was survival)
Freshwater Fish (Acute) Rainbow trout (*Oncorhynchus mykiss*)	LC_{50} (96-hr) = 158 µg a.i./L	40098001	Supplemental	Adequate for RQ calculation (reported as 156 in the M&E volume); no slope could be calculated
Freshwater Fish (Chronic) Rainbow trout (*Oncorhynchus mykiss*)	NOAEC = 110 µg a.i./L	425717-01	Acceptable	Early life-stage study; LOAEC (234 µg a.i./L) based on increased time to swim up
Estuarine/ Marine Invertebrate (Acute) Eastern oyster (*Crassostrea virginica*)	EC_{50} >114 mg a.i./L	444992-01	Acceptable	96-hr shell-deposition study; NOAEC = 83 mg a.i./L (based on 16% decrease in shell deposition)
Estuarine/ Marine Invertebrate (Chronic) Mysid (*Mysidopsis bahia*)	NOAEC = 3.1 µg a.i./L	444992-02	Acceptable	Flow-through, life-cycle study; LOAEC (234 µg a.i./L) based on decreased number of neonates produced, decreased survival, decreased weight, and decreased length
Estuarine/ Marine Fish	No acute or chronic exposure data available			
Aquatic Non-Vascular and Vascular Plants	No data available			

Table 5. Summary of Submitted Studies for Aquatic Organisms Exposed to Technical DDVP (Most Sensitive Endpoints for Each Taxon).

TAXON & SPECIES	ENDPOINT	MRID	STUDY CLASS-IFICATION	COMMENTS
Freshwater Invertebrates (Acute) Water flea (*Daphnia pulex*)	EC_{50} = 0.066 µg a.i./L	40098001	Acceptable	None
Freshwater Invertebrates (Chronic) Water flea (*Daphnia magna*)	NOAEC = 0.0058 µg a.i./L	43890301	Acceptable	LOAEC (0.0122 µg a.i./L) based on reduced egg production and growth (length and weight)
Freshwater Fish (Acute) Cutthroat trout (*Oncorhynchus clarki*)	LC_{50} = 170 µg a.i./L	40098001	Acceptable	None
Freshwater Fish (Chronic) Rainbow trout (*Oncorhynchus mykiss*)	NOAEC = 5.2 µg a.i./L	43788001	Acceptable	LOAEC (10.1 µg a.i./L) based on decreased post-hatch larval survival
Estuarine/ Marine Invertebrates (Acute) Mysid (*Americamysis bahia*)	EC_{50} = 19.1 µg a.i./L	43571408	Acceptable	None
Estuarine/ Marine Invertebrates (Chronic) Mysid (*Americamysis bahia*)	NOAEC = 1.48 µg a.i./L	43854301	Acceptable	LOAEC (3.25 µg a.i./L) based on reduced growth (weight and length)
Estuarine/ Marine Fish (Acute) Sheepshead minnow (*Cyprinodon variegates*)	LC_{50} = 7,350 µg a.i./L	43571403	Acceptable	None
Estuarine/ Marine Fish (Chronic) Sheepshead minnow (*Cyprinodon variegates*)	NOAEC = 960 µg a.i./L	43790401	Acceptable	LOAEC (1840 µg a.i./L) based on reduced survival and length
Aquatic Non-Vascular and Vascular Plants	No acceptable data available			

4.2. Effects to Terrestrial Organisms

Trichlorfon is classified as moderately toxic to mammals on an acute oral basis. There are currently no acceptable trichlorfon acute oral or sub-acute dietary toxicity data for birds. DDVP is classified as very highly toxic and moderately toxic to birds on an acute oral and sub-acute dietary exposure basis, respectively, and is classified as moderately toxic to mammals on an acute oral exposure basis. Trichlorfon is practically nontoxic and DDVP is highly toxic to honey bees on an acute contact exposure basis (**Table 6**). Available data on the toxicity of trichlorfon and DDVP to terrestrial organisms are summarized in Table 7 and Table 8, respectively.

Table 6. Classifications of Acute Toxicities of Trichlorfon and DDVP to Terrestrial Animals.

TAXON	Trichlorfon	DDVP
Mammals	Moderately toxic[1]	Moderately toxic[1]
Birds	No data	Very highly toxic[2]
Honey bees	Practically non-toxic[3]	Highly toxic[4]

[1] LD_{50} 51 -500 mg/kg
[2] LD_{50} <10 mg/kg
[3] LD_{50} >11 µg/bee
[4] LD_{50} <2 µg/bee

For trichlorfon, chronic effects in terrestrial animals include diminished reproduction (birds) and growth (mammals). For DDVP, chronic effects in terrestrial animals include diminished reproduction (birds and mammals) and growth (mammals).

As with aquatic animals, DDVP appears to be more or equally as toxic to terrestrial animals when compared to trichlorfon on both an acute and chronic exposure basis.

No terrestrial plant data are available for trichlorfon or DDVP.

Table 7. Summary of Submitted Studies for Terrestrial Animals Exposed to Technical Trichlorfon (Most Sensitive Endpoints for Each Taxon).

TAXON & SPECIES	ENDPOINT	MRID	STUDY CLASS-IFICATION	COMMENTS
Birds (Acute)	No acceptable acute data available			
Birds (Sub-acute)	No acceptable acute data available			
Birds (Chronic) Bobwhite quail (*Colinus virginianus*)	NOAEC = 9 mg/kg-diet	43119501	Acceptable	LOAEC (30 mg/kg-diet) based on a decrease in hatchling survival (no eggshell thickness effects at any level – highest = 85 ppm); there were 10 mortalties (1 control, 1 at the 8 ppm conc., and 8 at the 85 ppm conc.)
Mammals (Acute) Laboratory rat (*Rattus norvegicus*)	LD_{50} = 136 mg a.i./kg-bw	00256446	Acceptable	None
Mammals (Chronic) Laboratory rat (Sprague-Dawley)	NOAEC = 500 mg a.i./kg-diet	42228301	Acceptable	LOAEC (1,750 mg a.i./kg-diet) based on reduced body weight and dilated renal pelvis in F_1 males and females
Terrestrial Invertebrates Honey bee (*Apis mellifera*)	LD_{50} = 59.83 µg a.i./bee (acute contact)	ACC 00036935 (Atkins *et al*., 1975)	Acceptable	This study involved exposures of honey bees to trichlorfon in a formulated product. The slope for this study was 2.81.

Table 8. Summary of Submitted Studies for Terrestrial Animals Exposed to Technical DDVP (Most Sensitive Endpoints for Each Taxon).

TAXON & SPECIES	ENDPOINT	MRID	STUDY CLASS-IFICATION	COMMENTS
Birds (Acute) Bobwhite quail (*Colinus virginianus*)	LD_{50} = 8.8 mg a.i./kg bw	40818301	Acceptable	None
Birds (Sub-acute) Ring-necked pheasant (*Phasianus colchicus*)	LC_{50} = 568 mg a.i./kg-diet	0022923	Acceptable	None
Birds (Chronic) Mallard duck (*Anas platyrhynchos*)	NOAEC = 5 mg a.i./kg-diet	44233401	Acceptable	LOAEC (15 mg a.i./kg-diet) based on reduced eggshell thickness, eggs laid, and number of viable embryos
Mammals (Acute) Laboratory rat (*Rattus norvegicus*)	LD_{50} = 56 mg a.i./kg-bw	0005467	Acceptable	None
Mammals (Chronic) Laboratory rat (*Rattus norvegicus*)	NOAEC = 20 mg a.i./kg-diet LOAEC = 80 mg a.i./kg-diet	42483901	Acceptable	Based on reduced fertility and pup weight
Terrestrial Invertebrates Honey bee (*Apis mellifera*)	LD_{50} = 0.5 µg a.i./bee (contact)	00036935	Acceptable	None

4.3. Incident Database Review

A preliminary review on October 20, 2008, of the Ecological Incident Information System (EIIS, version 2.0) maintained by the Agency's Office of Pesticide Programs (OPP) indicates a total of 4 reported ecological incidents associated with the use of trichlorfon and 5 associated with the use of DDVP (Table 9). All of the trichlorfon incidents occurred between 1973 and 2003. Three of the trichlorfon incidents involved aquatic animals (*i.e.*, fish) and one involved terrestrial animals (*i.e.*, birds) and all were associated with mortality of the affected animals. The certainty categories for the four incidents ranged from possible (two incidents) to probable (two incidents), and two of the incidents involved registered uses while the remaining two involved misuses. Three of the incidents involved additional chemicals besides trichlorfon. Trichlorfon residues were reported in only one of the incident reports (see Table 9). The reported incidents for trichlorfon involved two uses that are no longer registered (alfalfa and agricultural area) and two uses that are currently registered (lawn and golf course). The two currently registered uses had certainty categories of probable and possible.

All of the DDVP incidents occurred between 1973 and 1997. One of the DDVP incidents involved aquatic animals (*i.e.*, fish) and four involved terrestrial animals (*i.e.*, birds and mammals). All of the aquatic incidents involved mortality while the terrestrial incidents involved mortality and/or incapacitation with recovery. The certainty categories for the five incidents ranged from possible (two incidents) to highly probable [probable (two incidents); highly probable (one incident)], and two of the incidents involved registered uses while the legality of use was undetermined for the remaining three. Only one of the incidents involved additional chemicals besides DDVP. DDVP residues were reported in one of the incident reports and ChE inhibition (brain) was reported in another (see Table 9). The use site for one of the reported DDVP incidents was unknown. The remaining four incidents involved the following use sites: industrial operation, agricultural area, building (inside), and apple.

Although incident reports for trichlorfon and DDVP have not been received by the Agency since 2003 and 1997, respectively, the absence of reported incidents should not be construed as the absence of incidents. Incident reports for non-target organisms typically provide information on mortality events only. Reports for other adverse effects, such as reduced growth or impaired reproduction, are rarely received. EPA's changes in the registrant reporting requirements for incidents in 1998 may also account for the reduced number of reported incidents. Registrants are now only required to submit detailed information on 'major' incidents. Minor incidents are generally reported aggregately and are not included in EIIS. In addition, there have been changes in state monitoring efforts due to lack of resources. However, the incident data that are available suggest that exposure pathways are complete and that exposure levels are sufficient to result in field-observable effects.

Table 9. Wildlife Incidents from the EIIS Associated with Trichlorfon or DDVP.

CHEM. NAME	INCIDENT NO.	TAXA INVOLVED	MAGNITUDE	YEAR	LOCATION	USE	LEGALITY OF USE	CERTAINTY CATEGORY	RESIDUES	OTHER CHEMICALS INVOLVED
Trichlorfon	B0000-224	Aquatic animal	~1,000 fish (carp, sunfish, and catfish)	1973	California	Alfalfa	Misuse	Possible	8.3 – 12 ppb in affected water	Endosulfan (0.3-0.59 ppb in affected water) Toxaphene (3.5 ppb in affected water)
	I000223-001	Aquatic animal	~100 dead bluegill sunfish	1992	Indiana	Lawn	Registered use	Probable	No	Isazofos (5.5 ppb in pond water)
	I008255-010	Terrestrial animal	2 dead geese	1998	USA	Agricultural area	Registered use	Possible	No	None
	I014538-013	Aquatic animal	~1,500 dead fish	2003	Indiana	Golf course	Misuse (rinsate released into pond)	Possible	No	Chlorithalonil Propiconazole
DDVP	B0000-500-31	Aquatic animal	379 dead fish	1973	Tennessee	Industrial operation	Undetermined	Probable	No	None
	B0000-500-21	Terrestrial animal	8 dead mallard ducks	1975	USA	Agricultural area	Registered use	Highly probable	No but there was brain ChE inhibition	None
	I002298-001	Terrestrial animal	5 dead fox pups (captive); 2 incapacitated fox pups (captive)	1995	USA	Building (inside)	Registered use	Possible	No	None
	I003908-011	Terrestrial animal	2 bluebird chicks	1994	New York	Apple	Undetermined	Probable	No	None
	I019411-016	Terrestrial Animal	1 debilitated red-tailed hawk	1997	British Columbia, Canada	Unknown	Undetermined	Possible	28 ppm in crop contents	Naled (73 ppm in crop contents) Fonofos (14 ppm in crop contents)

4.4. Ecosystems Potentially at Risk

The ecosystems at risk are often extensive in scope; therefore, it may not be possible to identify specific ecosystems during the development of a nation-wide ecological risk assessment. However, in general terms, terrestrial ecosystems potentially at risk could include the treated field and immediately adjacent areas that may receive drift or runoff. Areas adjacent to the treated field could include cultivated fields, fencerows and hedgerows, meadows, fallow fields or grasslands, woodlands, riparian habitats and other uncultivated areas.

Aquatic ecosystems potentially at risk (beyond the aquatic use sites) include water bodies adjacent to, or down stream from, the treated field and could include impounded bodies such as ponds, lakes and reservoirs, or flowing waterways such as streams or rivers. For uses in coastal areas, aquatic habitat also includes marine ecosystems, including estuaries.

5. Assessment Endpoints

Assessment endpoints represent the actual environmental value that is to be protected, defined by an ecological entity (species, community, or other entity) and its attribute or characteristics (USEPA 1998). For trichlorfon, the ecological entities may include the following: birds, mammals, terrestrial-phase amphibians, reptiles, freshwater fish and invertebrates, aquatic-phase amphibians, estuarine/marine fish and invertebrates, terrestrial plants, insects, and aquatic plants and algae. The attributes for each of these entities may include growth, reproduction, and survival.

6. Conceptual Model

For a pesticide to pose an ecological risk, it must reach ecological receptors in biologically significant concentrations. An exposure pathway is the means by which a pesticide moves in the environment from a source to an ecological receptor. For an ecological pathway to be complete, it must have a source, a release mechanism, an environmental transport medium, a point of exposure for ecological receptors, and a feasible route of exposure.

The conceptual model for trichlorfon provides a written description and visual representation of the predicted relationships among trichlorfon (and its degradate DDVP), potential routes of exposure, and the predicted effects for the assessment endpoint. A conceptual model consists of two major components: risk hypothesis and a conceptual diagram (USEPA 1998).

The primary environmental concerns identified in the 1997 and 2000 environmental fate and ecological risk assessments for trichlorfon were acute and chronic risks to birds, mammals, fish, and aquatic invertebrates (USEPA 1997, 2000). However, these risks did

not include a consideration of the trichlorfon degradate DDVP. Based on available data, DDVP is more or equally as toxic to aquatic and terrestrial animals when compared to trichlorfon. Therefore, risks to non-target species may be greater than previously assumed once DDVP is considered in the risk assessment process. Due to the number of data gaps that currently exist for trichlorfon and DDVP (see Section 7.8), preliminary RQs for trichlorfon will not be calculated in this problem formulation. The Agency believes that calculating RQs for trichlorfon use at this time would not be informative due to the uncertainties associated with the current data gaps.

6.1. Risk Hypothesis

A risk hypothesis describes the predicted relationship between the stressor, exposure, and assessment endpoint response. For trichlorfon, the following ecological risk hypothesis is being employed for this ecological risk assessment:

> *Based on the application methods, mode of action, fate and transport, and the sensitivity of non-target aquatic and terrestrial species, trichlorfon residues of concern (including trichlorfon and its degradate DDVP) have the potential to reduce survival, reproduction, and/or growth in non-target terrestrial and aquatic organisms when used in accordance with current trichlorfon labels. These non-target organisms include Federally listed threatened and endangered species as well as non-listed species.*

6.2. Conceptual Diagram

The environmental fate properties of trichlorfon and DDVP indicate that runoff, spray drift, volatilization and direct spray represent potential transport mechanisms of trichlorfon and DDVP to aquatic and terrestrial habitats where non-target organisms may be exposed. These transport mechanisms (*i.e.*, sources) are depicted in the conceptual models below (Figure 2 and Figure 3) along with the receptors of concern and the potential attribute changes in the receptors due to exposures of trichlorfon and DDVP.

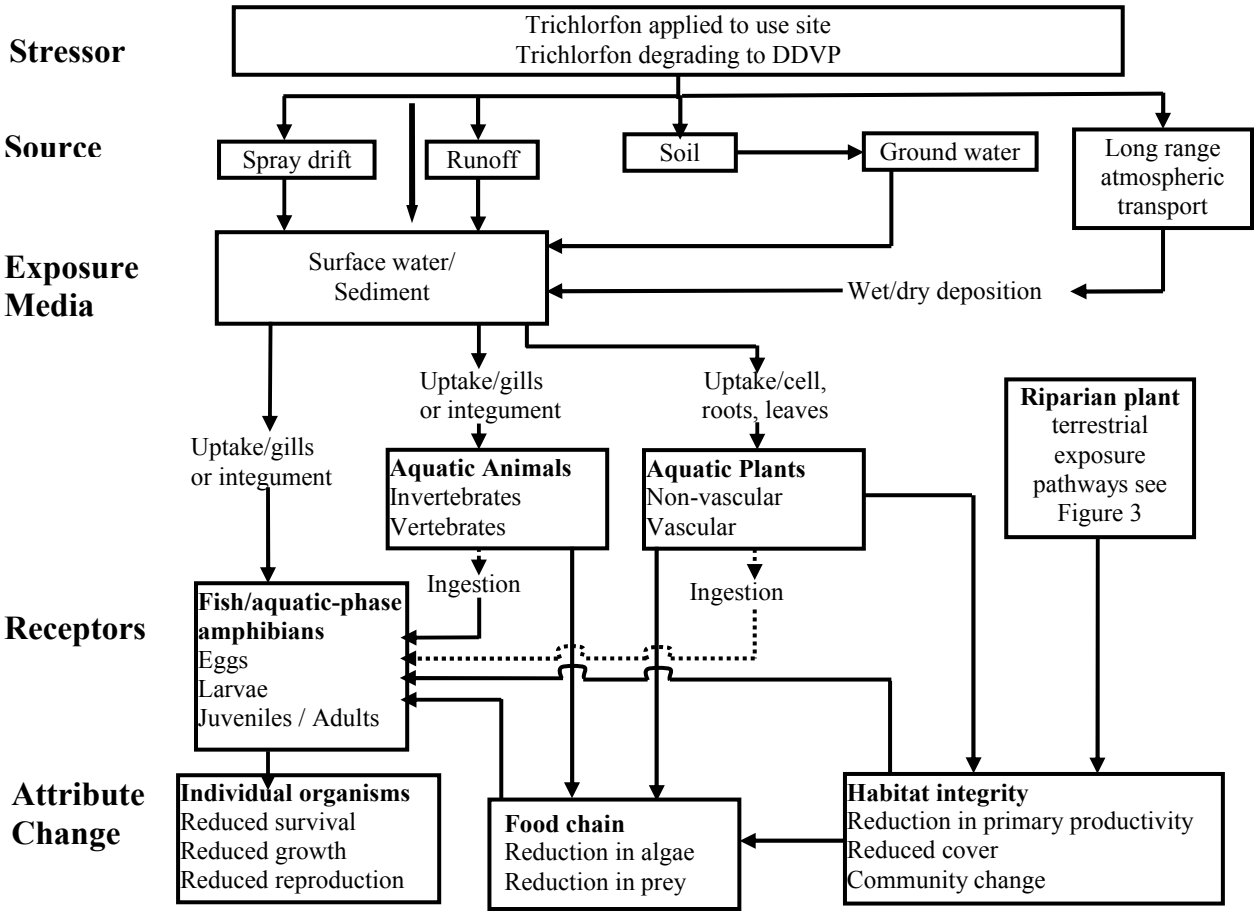


Figure 2. Conceptual model for trichlorfon and DDVP effects on aquatic organisms.

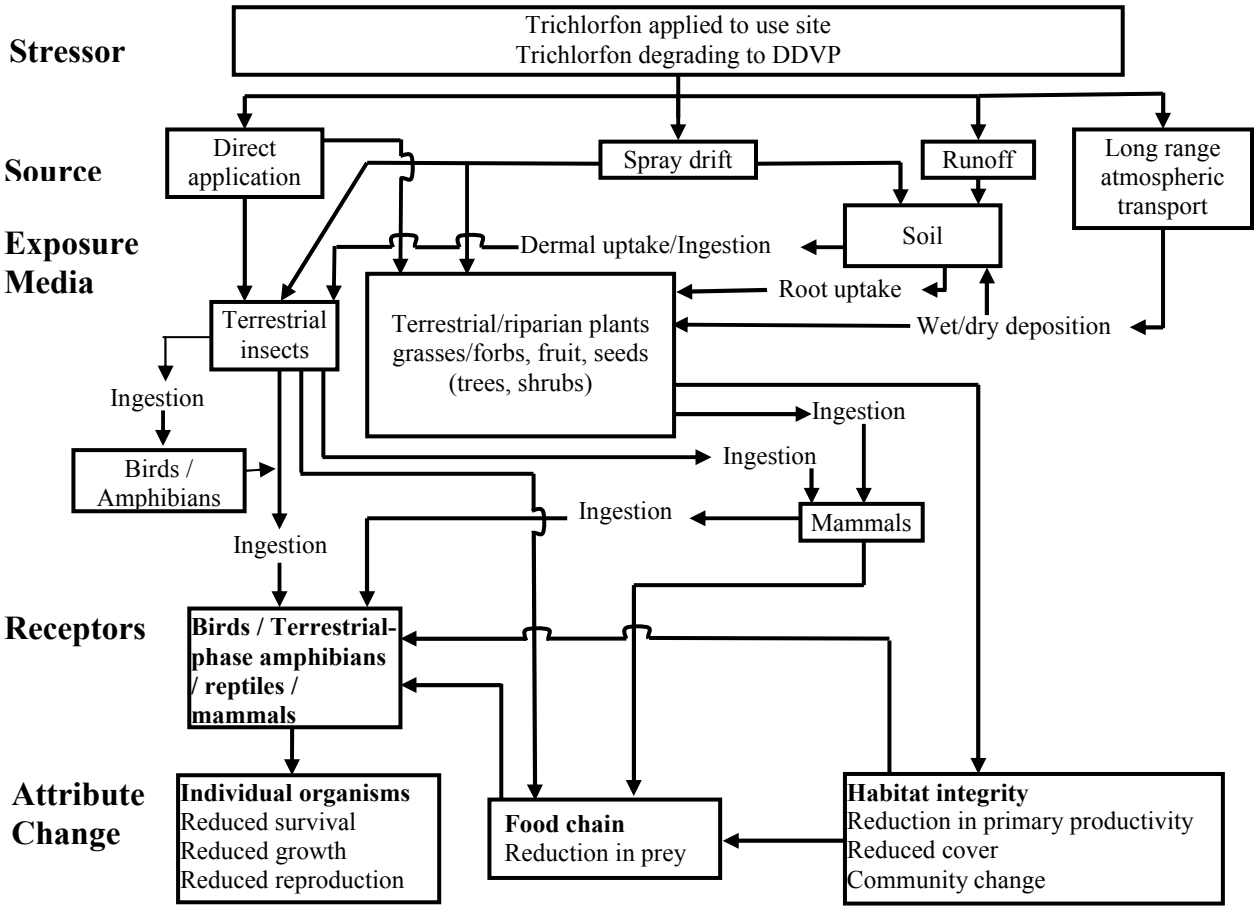


Figure 3. Conceptual model for trichlorfon and DDVP effects on terrestrial organisms.

7. Analysis Plan

In order to address the risk hypothesis, the potential for adverse effects on the environment is estimated. The use, environmental fate, and ecological effects of trichlorfon (and DDVP) are characterized and integrated to assess the risks using a 'total trichlorfon residues of concern' approach. In this approach, estimated environmental concentrations (EECs) will be derived for combined trichlorfon and DDVP. Risk quotients (RQs) will be derived for the total residues of concern by dividing EECs by the most sensitive endpoint from the available toxicity data for trichlorfon and DDVP.

This analysis plan will be revisited and may be revised depending upon the data available in the open literature and the information submitted by the public in response to the opening of the Registration Review docket.

7.1. Stressors of Concern

The primary degradate of concern, DDVP, is considered to have attributes and effects similar to parent trichlorfon. Thus, DDVP degradate residue levels will be considered along with trichlorfon residue levels as 'total trichlorfon residues of concern' in this assessment, and model results (exposure estimates) will reflect the predicted fate of both trichlorfon and DDVP resulting from trichlorfon usage.

In its ecological risk assessments, the Agency does not routinely include an evaluation of mixtures of active ingredients, either those mixtures of multiple active ingredients in product formulations or those in the applicator's tank. In the case of the product formulations of active ingredients (that is, a registered product containing more than one active ingredient), each active ingredient is subject to an individual risk assessment for regulatory decision regarding the active ingredient on a particular use site. If effects data are available for a formulated product containing more than one active ingredient, the data may be used qualitatively or quantitatively in accordance with the Agency's Overview Document and the Services' Evaluation Memorandum (USEPA 2004; USFWS/NMFS 2004).

Available toxicity data for environmental mixtures of trichlorfon with other pesticides will be presented as part of the ecological risk assessment. It is expected that the toxic effect of trichlorfon, in combination with other pesticides used in the environment, is likely to be a function of many factors including but not necessarily limited to: (1) the exposed species, (2) the co-contaminants in the mixture, (3) the ratio of trichlorfon and co-contaminant concentrations, (4) differences in the pattern and duration of exposure among contaminants, and (5) the differential effects of other physical/chemical characteristics of the receiving waters (*e.g.* organic matter present in sediment and suspended water). Quantitatively predicting the combined effects of all these variables on mixture toxicity to any given taxa with confidence is beyond the capabilities of the available data and methodologies. However, a qualitative discussion of implications of the available pesticide mixture effects data on the confidence of risk assessment conclusions will be addressed as part of the uncertainty analysis.

7.2. Measures of Exposure

In order to estimate risks of trichlorfon and DDVP exposures in aquatic and terrestrial environments, all exposure modeling and resulting risk conclusions will be made based on the maximum application rates for turfgrass, flowers, shrubs, trees, and ponds discussed in Section 3.2. Measures of exposure are based on aquatic and terrestrial models that predict estimated environmental concentrations of trichlorfon residues of concern using maximum labeled application rates and methods, as well as any mitigation measures specifically indicated on the label (*e.g.* spray drift buffers). The models used to predict aquatic EECs are the Pesticide Root Zone Model coupled with the Exposure Analysis Model System (PRZM/EXAMS). The model used to predict terrestrial EECs on food items is T-REX. These models are parameterized using relevant reviewed registrant-submitted environmental fate data.

PRZM (v3.12.2, May 2005) and EXAMS (v2.98.4.6, April 2005) are screening simulation models coupled with the input shell pe5.pl (Aug 2007) to generate daily exposures and 1-in-10 year EECs of trichlorfon residues of concern that may occur in surface water bodies adjacent to application sites receiving trichlorfon through runoff and spray drift. PRZM simulates pesticide application, movement and transformation on an agricultural field and the resultant pesticide loadings to a receiving water body via runoff, erosion and spray drift. EXAMS simulates the fate of the pesticide and resulting concentrations in the water body. The standard scenario used for ecological pesticide assessments assumes application to a 10-hectare agricultural field that drains into an adjacent 1-hectare water body that is 2 meters deep (20,000 m^3 volume) with no outlet. PRZM/EXAMS is used to estimate screening-level exposure of aquatic organisms to trichlorfon residues of concern. The measure of exposure for aquatic species is the 1-in-10 year return peak or rolling mean concentration. The 1-in-10 year peak is used for estimating acute exposures of direct effects to aquatic organisms. The 1-in-10-year 60-day mean is used for assessing chronic exposure to fish and aquatic-phase amphibians. The 1-in-10-year 21-day mean is used for assessing aquatic invertebrate chronic exposure.

Exposure estimates for terrestrial animals assumed to be in the target area or in an area exposed to spray drift are derived using the T-REX model (version 1.3.1, 12/07/2006). This model incorporates the Kenega nomograph, as modified by Fletcher *et al.* (1994), which is based on a large set of actual field residue data. The upper limit values from the nomograph represent the 95th percentile of residue values from actual field measurements (Hoerger and Kenega, 1972). The Fletcher *et al.* (1994) modifications to the Kenega nomograph are based on measured field residues from 249 published research papers, including information on 118 species of plants, 121 pesticides, and 17 chemical classes. EECs for terrestrial plants inhabiting dry and wetland areas are derived using TerrPlant (version 1.2.2, 12/26/2006). This model uses estimates of pesticides in runoff and in spray drift to calculate EECs. EECs are based upon solubility, application rate and minimum incorporation depth.

Exposure estimates for birds (and, thus, terrestrial-phase amphibians and reptiles), terrestrial invertebrates, and mammals assumed to be in the target area or in an area exposed to trichlorfon granules are derived using the T-REX model (version 1.3.1, 12/07/2006). T-REX includes the capability to calculate the LD_{50} ft^{-2} risk index values. Conceptually, an LD_{50} ft^{-2} is the amount of a pesticide estimated to kill 50% of exposed animals in each square foot of applied area. Although a square foot does not have defined ecological relevance and any unit area could be used, risk presumably increases as the number of $LD_{50}s/ft^2$ increases. The LD_{50}/ft^2 is used to estimate risk for granular formulations and row, banded, and in-furrow applications. For additional information on the LD_{50} ft^{-2} risk index, please reference U.S. EPA (1992). The LD_{50} ft^{-2} is calculated using a toxicity value (adjusted LD_{50}) and the EEC (mg a.i. ft^{-2}) and is directly compared with the Agency's levels of concern (LOCs).

The AgDRIFT spray drift model (version 2.01; dated 5/24/2001) is used to assess exposures of terrestrial organisms to trichlorfon deposited on terrestrial habitats by spray drift. AgDRIFT will also be used to determine the appropriate PRZM/EXAMS parameter values for modeling the percent drift corresponding to the buffers indicated on the label and to model areas of effect for aquatic and terrestrial taxa.

Any available monitoring data obtained from the scientific literature or submitted studies will be used to characterize exposures of trichlorfon and DDVP to non-target organisms.

7.3. Measures of Effect

Ecological effects data are used as measures of direct and indirect effects to biological receptors. Data are obtained from registrant-submitted studies or from literature studies identified by ECOTOX. The ECOTOX database (USEPA 2007*a*) provides more ecological effects data in an attempt to bridge existing data gaps. ECOTOX is a source for locating single chemical toxicity data and potential chemical mixture toxicity data for aquatic life, terrestrial plants, and wildlife. ECOTOX was created and is maintained by the USEPA, Office of Research and Development, and the National Health and Environmental Effects Research Laboratory's Mid-Continent Ecology Division.

Information on the potential effects of trichlorfon (and DDVP) on non-target animals is also collected from the Ecological Incident Information System (EIIS; USEPA 2007b). The EIIS is a database containing adverse effect (typically mortality) reports on non-target organisms where such effects have been associated with the use of pesticides.

Where available, sublethal effects observed in both registrant-submitted and open literature studies will be evaluated qualitatively. Such effects may include behavioral changes (*e.g.*, lethargy and changes in coloration). Quantitative assessments of risks, though, are limited to those endpoints that can be directly linked to the Agency's assessment endpoints of impaired survival, growth and reproduction.

The assessment of risk for direct effects to non-target organisms makes the assumption that toxicity of trichlorfon and DDVP to birds is similar to terrestrial-phase amphibians and reptiles. The same assumption is made for fish and aquatic-phase amphibians.

The acute measures of effect used for animals in this assessment are the LD_{50}, LC_{50} and EC_{50}. LD stands for "Lethal Dose", and LD_{50} is the amount of a material, given all at once, that is estimated to cause the death of 50% of the test organisms. LC stands for "Lethal Concentration" and LC_{50} is the concentration of a chemical that is estimated to kill 50% of the test organisms. EC stands for "Effective Concentration" and the EC_{50} is the concentration of a chemical that is estimated to produce a specific effect in 50% of the test organisms. Endpoints for chronic measures of exposure for listed and non-listed animals are the NOAEL/NOAEC and NOEC. NOAEL stands for "No Observed-Adverse-Effect-Level" and refers to the highest tested dose of a substance that has been reported to have no harmful (adverse) effects on test organisms. The NOAEC (*i.e.*, "No-Observed-Adverse-Effect-Concentration") is the highest test concentration at which none

of the observed effects were statistically different from the control. The NOEC is the No-Observed-Effects-Concentration. For non-listed plants, only acute exposures are assessed (*i.e.*, EC_{25} for terrestrial plants and EC_{50} for aquatic plants); for listed plants either the NOAEC or EC_{05} is used.

7.4. Integration of Exposure and Effects

Risk characterization is the integration of exposure and ecological effects characterization to determine the potential ecological risk from the registered uses of trichlorfon and the likelihood of direct and indirect effects to non-target organisms in aquatic and terrestrial habitats. The exposure and toxicity effects data are integrated in order to evaluate the risks of adverse ecological effects on non-target species. For the assessment of trichlorfon risks, the risk quotient (RQ) method is used to compare exposure and measured toxicity values. EECs are divided by acute and chronic toxicity values. The resulting RQs are then compared to the Agency's Levels of Concern (LOCs) (USEPA 2004) (See Appendix B). These criteria are used to indicate when trichlorfon's uses, as directed on the labels, have the potential to cause adverse direct or indirect effects to non-target organisms. In addition, incident data from the EIIS will be considered as part of the risk characterization.

7.5. Deterministic and Probabilistic Assessment Methods

The quantitative assessment of risk will primarily depend on the deterministic point-estimate based approach described in the risk assessment. An effort will be made to further qualitatively describe risk using probabilistic tools that the Agency has developed. These tools have been reviewed by FIFRA Scientific Advisory Panels (http://www.epa.gov/scipoly/sap/index.htm) and have been deemed as appropriate means of refining assessments where deterministic approaches have identified risks.

7.6. Endangered Species Assessments

Consistent with the Agency's responsibility under the Endangered Species Act (ESA), the Agency will evaluate risks to Federally-listed threatened and/or endangered (listed) species from registered uses of trichlorfon. This assessment will be conducted in accordance with the Overview Document (USEPA 2004), provisions of the ESA, and the Services' *Endangered Species Consultation Handbook* (USFWS/NMFS, 1998).

The assessment of effects associated with the registration of trichlorfon (and its degradate DDVP) is based on an action area. The action area is considered to be the area directly or indirectly affected by the federal action, as indicated by the exceedance of Agency Levels of Concern (LOCs) used to evaluate direct or indirect effects. The Agency's approach to defining the action area under the provisions of the Overview Document (USEPA 2004) considers the results of the risk assessment process to establish boundaries for that action area with the understanding that exposures below the Agency's defined LOCs constitute a no-effect threshold. For the purposes of this assessment, attention will be focused on the footprint of the action (*i.e.*, the area where trichlorfon application occurs), plus all

areas where offsite transport (*i.e.*, spray drift, runoff, *etc.*) may result in potential exposure that exceeds the Agency's LOCs. Specific measures of ecological effect that define the action area for listed species include any direct and indirect effects and/or potential modification of its critical habitat, including reduction in survival, growth, and reproduction as well as the full suite of sublethal effects available in the effects literature. Therefore, the action area extends to a point where environmental exposures are below any measured lethal or sublethal effect threshold for any biological entity at the whole organism, organ, tissue, and cellular level of organization. In situations where it is not possible to determine the threshold for an observed effect, the action area is not spatially limited and is assumed to be the entire United States.

7.7. Drinking Water Assessment

A drinking water assessment will be conducted to support the human health risk assessment of trichlorfon in registration review. The drinking water assessment will incorporate model estimates of trichlorfon residues of concern (including DDVP and parent) in surface and ground waters. Concentrations of trichlorfon residues of concern in surface waters will be estimated using PRZM/EXAMS (see description above). Ground water estimates of concentrations of trichlorfon residues of concern will be estimated using the Screening Concentration in Ground Water (SCI-GROW) model (v.2.3, July 2003). The drinking water assessment will also include a summary of available surface and ground water monitoring data.

This drinking water assessment will consider all sources of DDVP, including direct applications of DDVP as a pesticide active ingredient, as well as uses of trichlorfon and naled (PC code: 034401), which both degrade to DDVP.

7.8. Preliminary Identification of Data Gaps

7.8.1. Fate

The environmental fate data requirements for trichlorfon are partially fulfilled with some data gaps still remaining (

Table 10). The data gaps are discussed below. Data Call-In (DCI) tables for these data gaps are provided in Appendix C.

Table 10. Available environmental fate data for trichlorfon and remaining data gaps.

Guideline	Description	MRID	Classification	Data Gap?	comments
835.2120	Hydrolysis	00148974	Invalid	**Yes**	[1]It appears that this study reports the same results as MRID 00157859. [2]Because trichlorfon is not expected to be volatile, data describing the photodegradation of trichlorfon in air are not necessary. [3]It appears that this study reports the same results as MRID 00157860. [4] Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart D state that these data are not required when the Log Kow of a chemical and its major degradates are <3. Based on a Log octanol-water partition coefficient of 0.30 (MRID 00162307) for trichlorfon and 0.60 for DDVP, these data are not required for trichlorfon or DDVP.
835.2240	Photodegradation in water	00148975	Supplemental	**Yes**	
835.2410	Photodegradation in soil	00148976	Invalid	**Yes**	
		40261401[1]	Invalid		
835.2370	Photodegradation in air	none	Not applicable	No[2]	
835.4100	Aerobic soil metabolism	00098625	Invalid	No	
		42243601	Acceptable		
835.4200	Anaerobic soil metabolism	00161359	Invalid	No	
		40279301	Invalid		
		42243601	Acceptable		
835.4300	Aerobic Aquatic Metabolism	none	Not applicable	**Yes**	
835.4400	Anaerobic Aquatic Metabolism	none	Not applicable	**Yes**	
835.1230 835.1240	Leaching and adsorption/ desorption	00148977	Invalid	**Yes**	
		40261402[3]	Invalid		
835.1410	Laboratory Volatility	40279302	Acceptable	No	
835.6100	Terrestrial Field Dissipation	40279303	Invalid	**Yes**	
		42322501	Invalid		
		45303501	Under review		
		45895501	Supplemental		
		47519201	Supplemental		
835.6200	Aquatic Field Dissipation	none	Not applicable	**Yes**	
850.1730	Accumulation in Fish	none	Not applicable	No[4]	

Hydrolysis

Acceptable data have not been provided to quantify the hydrolysis of trichlorfon. According to Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart N (data requirements for pesticides), hydrolysis data are required for pesticides with terrestrial or aquatic uses. Since trichlorfon uses are classified as terrestrial and aquatic, **acceptable hydrolysis data for trichlorfon should be submitted to fulfill OPPTS Guideline 835.2120.** These data are used to estimate the degradation of trichlorfon in aquatic systems and ultimately to derive aquatic EECs using PRZM/EXAMS.

In the case that these data are unavailable at the time risk assessments are conducted, it will be assumed that trichlorfon is stable to hydrolysis.

Aqueous Photolysis

Acceptable data have not been provided to quantify the aqueous photolysis of trichlorfon. According to Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart N (data requirements for pesticides), aqueous photolysis data are required for pesticides with terrestrial or aquatic uses. Although this represents a data gap, EFED does not recommend that the Agency request these data at this time because the available supplemental data are sufficient to characterize the photolysis of trichlorfon in the aquatic environment.

Photolysis on soil

Acceptable data have not been provided to quantify the photolysis of trichlorfon on soil. According to Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart N (data requirements for pesticides), soil photolysis data are required for pesticides with terrestrial or aquatic uses. Since trichlorfon uses are classified as terrestrial and aquatic, **acceptable soil photolysis data for trichlorfon should be submitted to fulfill OPPTS Guideline 835.2410.** These data are used to characterize the degradation of trichlorfon in soil. In the case that these data are not submitted, it will be assumed that trichlorfon is stable to photolysis on soil.

Aerobic and Anaerobic Aquatic Metabolism

Acceptable data have not been provided to quantify the metabolism of trichlorfon under aerobic and anaerobic aquatic conditions. According to Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart D (data requirements for pesticides), aerobic and anaerobic aquatic metabolism data are required for pesticides with terrestrial or aquatic uses. Since trichlorfon uses are classified as terrestrial and aquatic, **acceptable aerobic and anaerobic aquatic metabolism data for trichlorfon should be submitted to fulfill OPPTS Guidelines 835.4300 and 835.4400.** These data are used to estimate the degradation of trichlorfon in aquatic systems and ultimately to derive aquatic EECs using PRZM/EXAMS. In the case that these data are unavailable at the time risk assessments are conducted, PRZM/EXAMS input parameter guidance default values will be employed to account for aerobic and anaerobic aquatic metabolism.

Leaching and Adsorption/Desorption

At this time, there are no acceptable studies to quantify the adsorption and desorption characteristics of trichlorfon in U.S. soils. EFED recommends that the Agency request the submission of an acceptable study under OPPTS Guideline 835.1230 to define K_d and K_{OC} values of trichlorfon in U.S. soils. In the absence of these data, EFED will assume that there is no sorption of trichlorfon to soils or organic matter on the treatment site. In order to implement this in derivation of aquatic EECs, a K_{OC} value of 0 will be used to

parameterize PRZM/EXAMS. Input of a K_{OC} value >0 is expected to result in lower aquatic EECs. If acceptable data are provided, the uncertainties associated with this assumption will be reduced.

Terrestrial Field Dissipation

At this time, two supplemental studies are available to describe the dissipation of trichlorfon under terrestrial field conditions (MRIDs 45895501 and 47519201). An additional study has been submitted and is currently under review by EFED (MRID 45303501). At this time, no acceptable studies have been identified to fulfill the OPPTS Guideline 835.6100. Although this represents a data gap, EFED does not recommend that the Agency request these data at this time because the available supplemental data are sufficient to characterize the terrestrial field dissipation of trichlorfon.

Aquatic Field Dissipation

At this time, no acceptable studies are available to describe the dissipation of trichlorfon under aquatic field conditions. According to Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart D (data requirements for pesticides), aquatic field dissipation data are required for pesticides with aquatic uses. Since trichlorfon uses are classified as aquatic, **aquatic field dissipation data for trichlorfon should be submitted to fulfill OPPTS Guideline 835.6200.**

Environmental Chemistry Methods

Independently validated analytical methods for residues in soil and water (environmental chemistry methods) submitted by the registrant are used to evaluate analyses described in submitted environmental fate and ecological effects studies. Submitted analytical methods are also used by various Federal, State, Tribal, and local agencies to detect and monitor residues that are or are suspected to be in environmental compartments due to outdoor uses and accidental releases. Therefore, availability of these analytical methods is necessary in order to protect human health and the environment from trichlorfon residues in the environment. Independent laboratory validations for submitted analytical methods are necessary to confirm the levels of detection and quantitation reported in registrant-prepared validations.

Use of trichlorfon may impact surface water quality due to runoff of rain water and drift of residues. Therefore, analytical methods for are necessary for detecting trichlorfon residues in water and in soil or sediment.

In the absence of independently validated environmental chemistry methods, submitted environmental fate and ecological effects data may not be reviewable and entities outside the Agency may lack chemical-specific methods for analyses in environmental compartments. Independently validated environmental chemistry methods will be used to evaluate the submitted environmental fate and ecological effects data and will be made available to the public to support monitoring for trichlorfon residues.

7.8.2. Effects data for Trichlorfon

Although many submissions have been made to provide data on the effects of trichlorfon to aquatic and terrestrial organisms, several data gaps still exist (
Table **11** - Table 13). Data gaps include the following: avian acute oral toxicity, avian sub-acute dietary toxicity, estuarine/marine fish acute toxicity, estuarine/marine invertebrate acute toxicity, estuarine/marine fish early-life stage toxicity, and terrestrial and aquatic plant toxicity studies. The data gaps are discussed below.

Table 11. Available Ecological Effects Data for Terrestrial Animals Exposed to Trichlorfon and Remaining Data Gaps (Studies Classified as 'Invalid' are Not Included).

Guideline	Description	MRID/ Accession	Classification	Data Gap?	Comments
850.2100	Avian oral toxicity	None	Not applicable	**Yes**[1]	[1] An acute oral toxicity study using either a mallard duck or bobwhite quail AND passerines must be submitted to fulfill this data requirement. [2] Dietary toxicity studies using a waterfowl and an upland game species must be submitted to fulfill this data requirement.
850.2200	Avian dietary toxicity	None	Not applicable	**Yes**[2]	
850.2300	Avian reproduction	43019501	Acceptable	No	
		43019601	Acceptable		
850.3020	Honeybee acute contact toxicity	00036935	Acceptable	No	

Table 12. Available Ecological Effects Data for Aquatic Animals Exposed to Trichlorfon and Remaining Data Gaps (Studies Classified as 'Invalid' are Not Included).

Guideline	Description	MRID/ Accession	Classification	Data Gap?	comments
850.1075	Freshwater fish – Acute toxicity	40098001	Supplemental	No	[1] The new Part 158 data requirements specify that acute toxicity data are required on one estuarine/marine mollusk (guideline fulfilled), one estuarine/marine invertebrate (guideline not fulfilled), and one estuarine/marine fish (guideline not fulfilled). [2] A saltwater fish early-life stage test (850.1400) is required for trichlorfon because the acute toxicity value for saltwater fish is < 1 mg/L (using freshwater fish as a surrogate).
		65495	Supplemental		
		91766	Acceptable		
850.1075	Saltwater fish – Acute toxicity	None	Not applicable	**Yes[1]**	
850.1010	Freshwater invertebrates – Acute toxicity	40098001	Supplemental	No	
850.1025 850.1035 850.1045 850.1055	Saltwater invertebrates – Acute toxicity	444992	Acceptable	**Yes[1]**	
850.1300	Freshwater invertebrate – life cycle test	40452601	Acceptable	No	
850.1350	Saltwater invertebrates – life cycle test	44499202	Acceptable	No	
850.1400	Freshwater fish – early life stage test	42571701	Acceptable	No	
850.1400	Saltwater fish – early life stage test	None	Not applicable	**Yes[2]**	
850.1500	Fish – life cycle test	None	Not applicable	No	

Table 13. Available Ecological Effects Data for Plants Exposed to Trichlorfon and Remaining Data Gaps (Studies Classified as 'Unacceptable' are Not Included).

Guideline	Description	MRID	Classification	Data Gap?	comments
850.4100	Terrestrial Plant toxicity: Tier I seedling emergence	None	Not applicable	**Yes**[1]	[1] The new Part 158 data requirements specify that toxicity data are required for terrestrial and aquatic plants. [2] Tier II studies will be required if tested terrestrial species exhibit a 25% or greater detrimental effect in the Tier I study.
850.4225	Terrestrial Plant toxicity: Tier 2 seedling emergence	None	Not applicable	No[2]	
850.4150	Terrestrial Plant toxicity: Tier I vegetative vigor	None	Not applicable	**Yes**[1]	
850.4150	Terrestrial Plant toxicity: Tier 2 vegetative vigor	None	Not applicable	No[2]	
850.4400	Aquatic Plant Growth: algae	None	Not applicable	**Yes**[1]	
850.4400	Aquatic Plant Growth: vascular plants	None	Not applicable	**Yes**[1]	

Avian Acute Oral Toxicity

No acceptable avian acute oral toxicity data are currently available for trichlorfon. The new Part 158 data requirements [40 CFR Part 158 (CFR 40 2007) data requirements for conventional pesticides (72 FR 60934; USEPA 2007*c*)] specify that acute avian oral toxicity data be submitted for either a mallard duck or bobwhite quail AND a passerine species. Additionally, there is one possible ecological incident involving birds (geese) and the use of trichlorfon (I008255-010). There is also evidence to indicate that passerines are more sensitive to at least some OPs when compared to data from upland and game species. For example, dimethoate (an OP) is an order of magnitude more toxic to passerines than to upland/game species (USEPA 2008). Therefore, an avian oral toxicity test (OPPTS Guideline 850.2100; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/Drafts/850-2100.pdf) is required for either a mallard duck or bobwhite quail AND a passerine species, as specified in 40 CFR Part 158 (CFR40 2007). Trichlorfon registrants will need to submit a passerine study protocol for review by the Agency prior to initiation of the passerine study. If oral acute toxicity data are not submitted for either mallard duck or bobwhite quail AND passerines, EFED will assume acute risk to birds in its assessment of trichlorfon.

Avian Sub-Acute Dietary Toxicity

No acceptable avian sub-acute dietary toxicity data are currently available for trichlorfon. The new Part 158 data requirements [40 CFR Part 158 (CFR 40 2007) data requirements for conventional pesticides (72 FR 60934; USEPA 2007*c*)] specify that avian dietary

toxicity data be submitted for both a waterfowl and an upland game species. There are currently no acceptable acute oral or sub-acute dietary toxicity data available for trichlorfon. However, there is one possible ecological incident involving birds (geese) and the use of trichlorfon (I008255-010), indicating a potential risk to birds. Therefore, an avian dietary toxicity test (OPPTS Guideline 850.2200; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/Drafts/850-2200.pdf) is required for both a waterfowl and an upland game species, as specified in 40 CFR Part 158 (CFR40 2007). If dietary toxicity data are not submitted for birds, EFED will assume acute risk to birds in its assessment of trichlorfon.

Estuarine/Marine Fish Acute Toxicity

Acute toxicity data are not available for estuarine and marine fish. In the absence of these data, an acute-to-chronic ratio (ACR) would normally be derived and the acute toxicity to estuarine and marine fish would be estimated based on the ACR for freshwater fish. However, there are currently no toxicity data (acute or chronic) for estuarine/marine fish, therefore, an ACR cannot be derived. In addition, three of the four reported ecological incidents associated with the use of trichlorfon have involved fish kills. Therefore, an estuarine/marine fish acute toxicity test (OPPTS Guideline 850.1075; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/Drafts/850-1075.pdf) is required in order to fulfill the data requirement. In the absence of acute toxicity data for estuarine and marine fish, EFED will assume acute risk to non-listed and listed species of estuarine and marine fish.

Estuarine/Marine Invertebrate Acute Toxicity

Although, acute toxicity data are available for an estuarine/marine mollusk, no acute data are currently available for a non-mollusk estuarine/marine invertebrate. The new Part 158 data requirements specify that acute toxicity data are required on one estuarine/marine mollusk (guideline fulfilled) and one estuarine/marine invertebrate (guideline not fulfilled). In the absence of these data, an acute-to-chronic ratio (ACR) would normally be derived and the acute toxicity to estuarine/marine invertebrates would be estimated based on the ACR for freshwater invertebrates. However, the freshwater invertebrate data necessary for calculating the ACR are not available. Chronic data are not available for the most acutely sensitive freshwater species (*Pteronarcella badia*). Therefore, an estuarine/marine acute toxicity test (OPPTS Guideline 850.1035; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/Drafts/850-1035.pdf) is required in order to fulfill the data requirement. In the absence of acute toxicity data for estuarine and marine invertebrates, EFED will assume acute risk to non-listed and listed species of estuarine and marine invertebrates.

Chronic Toxicity Studies with Estuarine and Marine Fish

Chronic toxicity data are not available for estuarine and marine fish. In the absence of these data, an acute-to-chronic ratio (ACR) would normally be derived and the chronic toxicity to estuarine and marine fish would be estimated based on the ACR for freshwater fish. However, there are currently no toxicity data (acute or chronic) for estuarine/marine

fish, therefore, an ACR cannot be derived. Some of the reported ecological incidents associated with the use of trichlorfon have involved fish kills. Therefore, an estuarine/marine fish early life-stage toxicity test (OPPTS Guideline 850.1400; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/Drafts/850-1400.pdf) is required in order to fulfill the data requirement. In the absence of chronic toxicity data for estuarine and marine fish, EFED will assume chronic risk to non-listed and listed species of estuarine and marine fish.

Terrestrial Plant Toxicity Studies

Toxicity data for terrestrial plants are not available for trichlorfon. Based on the 40 CFR Part 158 data requirements, Tier I level seedling emergence and vegetative vigor terrestrial plant data are required for all insecticides. Therefore, this data gap must be filled, and seedling emergence terrestrial plant data (OPPTS Guideline 850.4100; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/Drafts/850-4100.pdf) and vegetative vigor terrestrial plant data (OPPTS Guideline 850.4150; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/Drafts/850-4150.pdf) are required for trichlorfon at the Tier 1 level. In the absence of Tier I data, EFED will assume risk to non-listed and listed terrestrial plants.

Aquatic Plant Studies

Toxicity data for vascular and non-vascular aquatic plants are not available. Based on the 40 CFR Part 158 data requirements, Tier I level non-target aquatic plant data are required for all insecticides. Therefore, this data gap must be filled, and non-target aquatic plant data for algae and vascular plants (OPPTS Guideline 850.4400; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/Drafts/850-4400.pdf) are required for trichlorfon at the Tier 1 level. In the absence of Tier I data, EFED will assume risk to non-listed and listed species of vascular and non-vascular aquatic plants.

7.8.3. Effects data for DDVP

Although much data has been provided on the effects of DDVP to aquatic and terrestrial organisms, several data gaps still exist (Tables 14-16)**.** Data gaps include the following: avian acute oral toxicity, life-cycle freshwater fish toxicity, and terrestrial and aquatic plant toxicity studies. The data gaps are discussed below.

Table 14. Available Ecological Effects Data for Terrestrial Animals Exposed to DDVP and Remaining Data Gaps (Only Studies with the most Sensitive Toxicity Endpoints are Reported).

Guideline	Description	MRID/ Accession	Classification	Data Gap?	Comments
850.2100	Avian oral toxicity	40818301	Acceptable	**Yes**[1]	1 The new Part 158 data requirements specify that acute avian oral toxicity data be submitted for either a mallard duck or bobwhite quail AND a passerine species. An acute oral toxicity study using passerines must be submitted to fulfill this data requirement.
850.2200	Avian dietary toxicity	0022923	Acceptable	No	
850.2300	Avian reproduction	44233401	Acceptable	No	
850.3020	Honeybee acute contact toxicity	00036935	Acceptable	No	

Table 15. Available Ecological Effects Data for Aquatic Animals Exposed to DDVP and Remaining Data Gaps (Only Studies with the most Sensitive Toxicity Endpoints are Reported).

Guideline	Description	MRID/ Accession	Classification	Data Gap?	comments
850.1075	Freshwater fish – Acute toxicity	40098001	Acceptable	No	None
850.1075	Saltwater fish – Acute toxicity	43571403	Acceptable	No	
850.1010	Freshwater invertebrates – Acute toxicity	40098001	Acceptable	No	
850.1025 850.1035 850.1045 850.1055	Saltwater invertebrates – Acute toxicity	43571408	Acceptable	No	
		43571404	Acceptable	No	
850.1300	Freshwater invertebrate – life cycle test	43890301	Acceptable	No	
850.1350	Saltwater invertebrates – life cycle test	43854301	Acceptable	No	
850.1400	Freshwater fish – early life stage test	43788001	Acceptable	No	
850.1400	Saltwater fish – early life stage test	43790401	Acceptable	No	
850.1500	Fish – life cycle test	None	Not applicable	No	

Table 16. Available Ecological Effects Data for Plants Exposed to DDVP and Remaining Data Gaps (Only Studies with the most Sensitive Toxicity Endpoints are Reported).

Guideline	Description	MRID	Classification	Data Gap?	comments
850.4100	Terrestrial Plant toxicity: Tier I seedling emergence	None	Not applicable	**Yes**[1]	[1] The new Part 158 data requirements specify that toxicity data are required for terrestrial and aquatic plants [2] Tier II studies will be required if tested terrestrial species exhibit a 25% or greater detrimental effect in the Tier I study.
850.4225	Terrestrial Plant toxicity: Tier 2 seedling emergence	None	Not applicable	No[2]	
850.4150	Terrestrial Plant toxicity: Tier I vegetative vigor	None	Not applicable	**Yes**[1]	
850.4150	Terrestrial Plant toxicity: Tier 2 vegetative vigor	None	Not applicable	No[2]	
850.4400	Aquatic Plant Growth: algae	None	Not applicable	**Yes**[1]	
850.4400	Aquatic Plant Growth: vascular plants	None	Not applicable	**Yes**[1]	

Avian Acute Oral Toxicity

Acceptable acute avian oral toxicity data were submitted for exposures of bobwhite quail to DDVP; however, data are not available for passerines, which are required under the new 40 CFR Part 158 (CFR 40 2007) data requirements for conventional pesticides (72 FR 60934; USEPA 2007*c*). The new Part 158 data requirements specify that acute avian oral toxicity data be submitted for either a mallard duck or bobwhite quail AND a passerine species. Based on the results of previous ecological risk assessments for DDVP, risks are expected for non-listed and listed birds due to acute exposures to DDVP from the use of trichlorfon. Additionally, three of the five ecological incidents associated with DDVP involved birds, including one involving passerines (bluebirds; I003908-011). Therefore, an avian oral toxicity test (OPPTS Guideline 850.2100; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/Drafts/850-2100.pdf) is required for passerine birds, as specified in 40 CFR Part 158 (CFR40 2007). Trichlorfan registrants will need to submit a passerine study protocol for review by the Agency prior to initiation of this study. If oral acute toxicity data are not submitted for passerines, EFED will assume acute risk for passerine species.

Terrestrial Plant Toxicity Studies

Toxicity data for terrestrial plants are not available for DDVP. Based on the 40 CFR Part 158 data requirements, Tier I level seedling emergence and vegetative vigor terrestrial plant data are required for all insecticides. Therefore, this data gap must be filled, and seedling emergence terrestrial plant data (OPPTS Guideline 850.4100; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/

Drafts/850-4100.pdf) and vegetative vigor terrestrial plant data (OPPTS Guideline 850.4150; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/Drafts/850-4150.pdf) are required for DDVP at the Tier 1 level. In the absence of Tier I data, EFED will assume risk to terrestrial plants.

Aquatic Plant Studies

Toxicity data for vascular and non-vascular aquatic plants are not available. Based on the 40 CFR Part 158 data requirements, Tier I level non-target aquatic plant data are required for all insecticides. Therefore, this data gap must be filled, and non-target aquatic plant data for algae and vascular plants (OPPTS Guideline 850.4400; http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/850_Ecological_Effects_Test_Guidelines/Drafts/850-4400.pdf) are required for trichlorfon at the Tier 1 level. In the absence of Tier I data, EFED will assume risk to both vascular and non-vascular aquatic plants.

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Appendix A. Submitted Toxicity Data for Trichlorfon and DDVP.

Studies classified as 'unacceptable' are excluded.

TABLE A.1. Submitted Toxicity Data for Trichlorfon (The studies with the most sensitive endpoint for each taxon are highlighted).

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
Birds (Chronic)					
Mallard duck (*Anas platyrhynchos*)	NOAEC = 27 mg/kg-diet LOAEC = 78 mg/kg-diet	Technical (99.8%)	43019601	Acceptable	Based on decrease in eggshell thickness (16% reduction compared to control) and percent viable embryos (i.e., %of eggs set); 4 birds at the 235 concentration died after exhibiting clinical signs of toxicity; 1 control bird died
Bobwhite quail (*Colinus virginianus*)	NOAEC = 9 mg/kg-diet LOAEC = 30 mg/kg-diet	Technical (99.8%)	43119501	Acceptable	Based on a decrease in hatchling survival (no eggshell thickness effects at any level – highest = 85 ppm); there were 10 mortalties (1 control, 1 at the 8 ppm concentration, and 8 at the 85 ppm conc.)
Terrestrial Invertebrates					
Honey bee (*Apis mellifera*)	LC_{50} > 1.20 lb a.i./acre	Formulation (SP, 80%)	AC0023 (Clinch, 1967)	Supplemental	Non-guideline study; insecticide sprayed from tower – honey bees enclosed with contaminated flowers for 1 hr (3 hrs after spray); no mortalities up to 24-hr after exposure; only 1 conc. tested.

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
Honey bee (*Apis mellifera*)	LC_{50} > 1.20 lb a.i./acre	Formulation (SP, 80%)	AC0008 (Clinch, 1969)	Supplemental	Non-guideline study; test to mimic fumigant toxicity; bees exposed for 1 hr; no 'fumigant toxicity' noted for trichlorfon; only 1 conc. tested.
Lady beetle (*Lindorus lophanthae*)	LC_{50} > 0.477% a.i. in honey (w/w) = 4,770 ppm (some mortality, specifics not provided except <50%)	Formulation (SP, 50%)	AA0Q01 (Bartlett, 1966)	Supplemental	Non-guideline; dietary study; pesticides mixed into honey bait; bees allowed to feed for 6 hrs, then held for 4 days; only 2 conc. tested.
Mealybug destroyer (*Cryptolaemus montrouzieri*)	LC_{50} > 0.477% a.i. in honey (w/w) = 4,770 ppm (some mortality, specifics not provided except <50%)				
Scale predator (*Aphytis melinus*)	LC_{50} = 0.477% a.i. in honey (w/w) = 4,770 ppm (up to 4-days after exposure)				
Parasitic wasp (*Metaphycus luteolus*)	LC_{50} = 0.477% a.i. in honey (w/w) = 4,770 ppm (up to 4-days after exposure)				
Alfalfa leafcutter bee (*Megachile rotundata*)	65% mortality (2 lb a.i./acre application rate) – when exposed to	Dylox SP (80%)	ACC 00001949 (Johansen and Eves, 1969)	Supplemental	Non-guideline; alfalfa treated using hand sprayer, bees were caged on treated foliage; mortality

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
	8-hr old residues				evaluated 24-hr post exposure; only 1 conc. tested
Honey bee (*Apis mellifera*)	44% mortality (2 lb a.i./acre application rate) – when exposed to 3-hr old residues	Dylox SP (80%)	ACC 00001949 (Johansen and Eves, 1969)	Supplemental	Non-guideline; alfalfa treated using hand sprayer, bees were caged on treated foliage; mortality evaluated 24-hr post exposure; only 1 conc. tested
Honey bee (*Apis mellifera*)	17% mortality (1 lb a.i./acre application rate) – when exposed to 3-hr old residues; 0% with 2-day old residues	Dylox SP (50%)	ACC 00060628 (Johansen and Eves, 1965)	Supplemental	Non-guideline; alfalfa treated using hand sprayer, bees were caged on treated foliage; mortality evaluated 48-hr post exposure; only 1 conc. tested
Alkali bee (*Nomia melanderi*)	31% mortality (1 lb a.i./acre application rate) – when exposed to 3-hr old residues; 10% with 2-day old residues	Dylox SP (50%)	ACC 00060628 (Johansen and Eves, 1965)	Supplemental	Non-guideline; alfalfa treated using hand sprayer, bees were caged on treated foliage; mortality evaluated 48-hr post exposure; only 1 conc. tested
Leafcutter bee (*Megachile rotundata*)	5% mortality (1 lb a.i./acre application rate) – when exposed to 3-hr old residues	Dylox SP (50%)	ACC 00060628 (Johansen and Eves, 1965)	Supplemental	Non-guideline; alfalfa treated using hand sprayer, bees were caged on treated foliage; mortality evaluated 48-hr post exposure; only 1 conc. tested
Honey bee (*Apis mellifera*)	LD_{50} = 59.83 µg a.i./bee (acute contact); slope – 2.81	Formulation	ACC 00036935 (Atkins *et al*., 1975)	Acceptable	A bell-jar vacuum duster was used to apply the pesticide, mixed with pyrolite dust diluent, to bees; observations up to 96-hrs post treatment
Ground beetle	100%	Formulation (80%)	ACC	Supplemental	Non-guideline;

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
(*Scarites substriatus*)	mortality at 1 lb a.i./acre		05008149 (Gholson *et al.*, 1978)		soil surface sprayed with pesticide; beetles placed in soil and mortality evaluated after 5 days; only 1 conc. tested
Ground beetle (*Pterostichus chalcites*)	100% mortality at 1 lb a.i./acre	Formulation (80%)	ACC 05008149 (Gholson *et al.*, 1978)	Supplemental	Non-guideline; soil surface sprayed with pesticide; beetles placed in soil and mortality evaluated after 5 days; only 1 conc. tested
Ground beetle (*Bembidion rapidum*)	97.5% mortality at 1 lb a.i./acre	Formulation (80%)	ACC 05008149 (Gholson *et al.*, 1978)	Supplemental	Non-guideline; soil surface sprayed with pesticide; beetles placed in soil and mortality evaluated after 5 days; only 1 conc. tested
Ground beetle (*Harpalus pensylvanicus*)	50% mortality at 1 lb a.i./acre	Formulation (80%)	ACC 05008149 (Gholson *et al.*, 1978)	Supplemental	Non-guideline; soil surface sprayed with pesticide; beetles placed in soil and mortality evaluated after 5 days; only 1 conc. tested
Freshwater Invertebrates (Acute)					
Daphnia pulex	EC_{50} (48-hr) = 0.18 µg/L	Technical	40098001	Supplemental	(also reported in 40094602); raw data from M&E not legible
Simocephalus serrulatus	EC_{50} (48-hr) = 0.70 µg/L	Technical	40098001	Supplemental	(also reported in 40094602); no raw data available
Simocephalus serrulatus	EC_{50} (48-hr) = 0.32 µg/L	Technical	40098001	Supplemental	No raw data available
Gammarus lacustris	EC_{50} (96-hr) = 40 µg/L	Technical	40098001	Supplemental	
Gammarus pseudolimnaeus	EC_{50} (96-hr) = 108 µg/L	Technical	40098001	Supplemental	
Gammarus pseudolimnaeus	EC_{50} (96-hr) = 275 µg/L	Technical	40098001	Supplemental	
Gammarus	EC_{50} (96-hr)	Technical	40098001	Supplemental	

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
pseudolimnaeus	= 90 µg/L				
Gammarus pseudolimnaeus	EC_{50} (96-hr) = 108 µg/L	Technical	40098001	Supplemental	
Gammarus pseudolimnaeus	EC_{50} (96-hr) = 119 µg/L	Technical	40098001	Supplemental	
Gammarus pseudolimnaeus	EC_{50} (96-hr) = >40 µg/L	Technical	40098001	Supplemental	
Gammarus pseudolimnaeus	EC_{50} (96-hr) = 43 µg/L	Technical	40098001	Supplemental	
Gammarus pseudolimnaeus	EC_{50} (96-hr) = 32 µg/L	Technical	40098001	Supplemental	
Gammarus pseudolimnaeus	EC_{50} (96-hr) = 17 µg/L	80% wettable powder	40098001	Supplemental	
Procambarus sp.	EC_{50} (96-hr) = 7,800 µg/L	Technical	40098001	Supplemental	
Procambarus sp.	EC_{50} (96-hr) = 13,300 µg/L	Technical	40098001	Supplemental	
Claassenia sabulosa	EC_{50} (96-hr) = 22 µg/L	Technical	40098001	Supplemental	
Isogenus sp.	EC_{50} (96-hr) = 24 µg/L	Technical	40098001	Supplemental	
Isogenus sp.	EC_{50} (96-hr) = 12 µg/L	80% wettable powder	40098001	Supplemental	
Pteronarcella badia	EC_{50} (96-hr) = 11 µg/L	Technical	40098001	Supplemental	Not enough information available in the raw data to confirm the results
Pteronarcella badia	EC_{50} (96-hr) = 100 µg/L	Technical	40098001	Supplemental	
Pteronarcella badia	EC_{50} (96-hr) = 9.8 µg/L	Technical	40098001	Supplemental	
Pteronarcella badia	EC_{50} (96-hr) = 5.3 µg/L	Technical	40098001	Supplemental	Adequate for RQ calculation; based on analysis of raw data, the slope is 5.2 (C.I.: 2.6 – 7.9)
Pteronarcys californica	EC_{50} (96-hr) = 35 µg/L	Technical	40098001	Supplemental	
Freshwater Invertebrates (Chronic)					
Daphnia magna	NOAEC = 0.0057 µg a.i./L LOAEC = 0.0086 µg a.i./L	Technical	40452601	Acceptable	Based on survival (all endpoints were affected in the study, the most sensitive was survival)
Freshwater Fish (Acute)					
Coho salmon	LC_{50} (24-hr) = >4,110	Technical	40098001	Supplemental	Flow-through

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
	µg/L				
Cutthroat trout	LC_{50} (96-hr) = 2,700 µg/L	Technical	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 6,800 µg/L	Technical	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 5,750 µg/L	Technical	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 1,680 µg/L	Technical	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 4,750 µg/L	Technical	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 375 µg/L	Technical	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 5,70 µg/L	Technical	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 620 µg/L	Technical	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 1,730 µg/L	Technical	40098001	Supplemental	"0 DAY DEGRA"
Cutthroat trout	LC_{50} (96-hr) = 470 µg/L	Technical	40098001	Supplemental	"7 DAY DEGRA"
Cutthroat trout	LC_{50} (96-hr) = 170 µg/L	Technical	40098001	Supplemental	"14 DAY DEGRA"
Cutthroat trout	LC_{50} (96-hr) = 340 µg/L	Technical	40098001	Supplemental	"21 DAY DEGRA"
Cutthroat trout	LC_{50} (96-hr) = 3,250 µg/L	80% wettable powder	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 5,220 µg/L	Technical	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 4,400 µg/L	Technical	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 6,170 µg/L	Technical	40098001	Supplemental	
Cutthroat trout	LC_{50} (96-hr) = 1,080 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,750 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,410 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 11,400 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,775 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 2,000 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 970 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 8,800 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,120 µg/L	Technical	40098001	Supplemental	

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
Rainbow trout	LC_{50} (96-hr) = 700 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 700 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,380 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 355 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 210 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 280 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 700 µg/L	80% wettable powder	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 700 µg/L	40.5% EC	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,400 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 4,250 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,020 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,820 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 860 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 72 µg/L	Technical	40098001	Supplemental	Not adequate for RQ calculation; legible raw data not available for review
Rainbow trout	LC_{50} (96-hr) = 158 µg/L	Technical	40098001	Supplemental	Adequate for RQ calculation (reported as 156 in the M&E volume); no slope could be calculated
Rainbow trout	LC_{50} (96-hr) = 1,400 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 3,500 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 5,850 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 167 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 3,500 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 4,500 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 310 µg/L	Technical	40098001	Supplemental	

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
Rainbow trout	LC_{50} (96-hr) = 2,600 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 2,500 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 780 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 820 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 430 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 370 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 580 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 780 µg/L	80% Wettable poweder	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 2,400 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,100 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 430 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 960 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 860 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 9,000 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 6,410 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,750 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 2,460 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 390 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 580 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 560 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 700 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 360 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 860 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,000 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,100 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 570 µg/L	Technical	40098001	Supplemental	

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
Rainbow trout	LC_{50} (96-hr) = 500 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 500 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 208 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 230 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 160 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,000 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 820 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 562 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 740 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 190 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 440 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 6,410 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,000 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 820 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 560 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 8,000 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 2,460 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 740 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 562 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 700 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,230 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 390 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 580 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 190 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 440 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 360 µg/L	Technical	40098001	Supplemental	

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
Rainbow trout	LC_{50} (96-hr) = 780 µg/L	Technical	40098001	Supplemental	
Rainbow trout	LC_{50} (96-hr) = 1,060 µg/L	80% Wettable powder	40098001	Supplemental	
Atlantic salmon	LC_{50} (96-hr) = 1,400 µg/L	Technical	40098001	Supplemental	
Atlantic salmon	LC_{50} (96-hr) = 2,000 µg/L	Technical	40098001	Supplemental	
Atlantic salmon	LC_{50} (96-hr) = 4,100 µg/L	Technical	40098001	Supplemental	
Atlantic salmon	LC_{50} (96-hr) = 580 µg/L	Technical	40098001	Supplemental	
Atlantic salmon	LC_{50} (96-hr) = 540 µg/L	Technical	40098001	Supplemental	
Atlantic salmon	LC_{50} (96-hr) = 380 µg/L	Technical	40098001	Supplemental	
Atlantic salmon	LC_{50} (96-hr) = 4,400 µg/L	Technical	40098001	Supplemental	
Atlantic salmon	LC_{50} (96-hr) = 610 µg/L	Technical	40098001	Supplemental	
Atlantic salmon	LC_{50} (96-hr) = 300 µg/L	Technical	40098001	Supplemental	
Atlantic salmon	LC_{50} (96-hr) = 2,970 µg/L	Technical	40098001	Supplemental	
Atlantic salmon	LC_{50} (96-hr) = 10,400 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 3,500 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 2,500 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 9,400 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 1,100 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 8,400 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 3,400 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 470 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 240 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 2,420 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 620 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 9,200 µg/L	80% Wettable powder	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 500 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr)	Technical	40098001	Supplemental	

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
	= 9,200 µg/L				
Brook trout	LC_{50} (96-hr) = 6,000 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 960 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 840 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 650 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 290 µg/L	Technical	40098001	Supplemental	
Brook trout	LC_{50} (96-hr) = 5,500 µg/L	40% EC	40098001	Supplemental	
Lake trout	LC_{50} (96-hr) = 550 µg/L	Technical	40098001	Supplemental	
Lake trout	LC_{50} (96-hr) = 1,030 µg/L	Technical	40098001	Supplemental	
Fathead minnow	LC_{50} (96-hr) = 7,900 µg/L	Technical	40098001	Supplemental	
Black bullhead	LC_{50} (96-hr) = 515 µg/L	Technical	40098001	Supplemental	
Channel catfish	LC_{50} (96-hr) = 2,200 µg/L	40.5% EC	40098001	Supplemental	
Channel catfish	LC_{50} (96-hr) = 7,600 µg/L	Technical	40098001	Supplemental	
Channel catfish	LC_{50} (96-hr) = 880 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 3,170 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = >50,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 50,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 10,300 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 10,300 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = >50,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 32,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 3,400 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,900 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr)	Technical	40098001	Supplemental	

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
	= 14,500 µg/L				
Bluegill	LC_{50} (96-hr) = 4,500 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 1,720 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 1,720 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 940 µg/L	80% Wettable powder	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 5,200 µg/L	40.5% EC	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,500 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 600 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 1,300 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 1,500 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 1,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,500 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,700 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 1,650 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,200 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 1,050 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 1,050 µg/L	80% Wettable powder	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 15,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 3,300 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 39,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 800 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 35,500 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 31,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 3,500 µg/L	Technical	40098001	Supplemental	

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
Bluegill	LC_{50} (96-hr) = 7,200 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,820 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 9,200 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 12,300 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 7,200 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 5,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 1,730 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 3,150 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,250 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 410 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 8,700 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 14,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 5,800 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 5,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,800 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 234 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 5,200 µg/L	40.5% EC	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 3,360 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 13,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 15,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 45,000 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 40,000 µg/L	Technical	40098001	Supplemental	

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
Bluegill	LC_{50} (96-hr) = 6,800 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 9,600 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 8,100 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,350 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,250 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 2,250 µg/L	Technical	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 1,050 µg/L	80% Wettable powder	40098001	Supplemental	
Bluegill	LC_{50} (96-hr) = 1,880 µg/L	Technical	40098001	Supplemental	
Largemouth bass	LC_{50} (96-hr) = 3,450 µg/L	Technical	40098001	Supplemental	
Yellow perch	LC_{50} (96-hr) = 3,450 µg/L	Technical	40098001	Supplemental	
Fathead minnow	LC_{50} (96-hr) = 110,000 µg/L	Technical	65495	Supplemental	Adequate for RQ calculation; No analytical verification was reported for any of the bioassays.
Bluegill	LC_{50} (96-hr) = 3,800 µg/L				
Goldfish	LC_{50} (96-hr) = 100,000 µg/L				
Guppy	LC_{50} (96-hr) = 7,200 µg/L				
Bluegill	LC_{50} (96-hr) = 2,200 µg/L	Technical	91766	Acceptable	
Rainbow trout	LC_{50} (96-hr) = 1,600 µg/L	Technical	91766	Acceptable	
Freshwater Fish (Chronic)					
Rainbow trout	NOAEC = 110 µg a.i./L LOAEC = 234 µg a.i./L	Technical	425717-01	Acceptable	Early life-stage study; endpoint based on increased time to swim up
Estuarine/Marine Invertebrates (Acute)					
Eastern oyster (*Crassostrea virginica*)	EC_{50} >114 mg a.i./L	Technical	444992-01	Acceptable	96-hr shell-deposition study; NOAEC = 83 mg a.i./L (based on 16% decrease in shell deposition)
Estuarine/Marine Invertebrates (Chronic)					
Mysid (*Mysidopsis bahia*)	NOAEC = 3.1 µg a.i./L LOAEC =	Technical	444992-02	Acceptable	Flow-through, life-cycle study; endpoints based on decreased

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
	6.7 µg a.i./L				number of neonates produced, decreased survival, dreased weight, and decreased length
Thalassiosire pseudonana	LC_{50} = >50 mg a.i./L				

TABLE A.2. Summary of the Studies with the Most Sensitive Endpoints from Submitted Toxicity Data for DDVP.

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
Birds (Acute)					
Bobwhite quail (*Colinus virginianus*)	LD_{50} = 8.8 mg a.i./kg bw	Technical	40818301	Acceptable	
Birds (Sub-Acute)					
Ring-necked pheasant (*Phasianus colchicus*)	LC_{50} = 568 mg a.i./kg-diet	Technical	0022923	Acceptable	
Birds (Chronic)					
Mallard duck (*Anas platyrhynchos*)	NOAEC = 5 mg a.i./kg-diet LOAEC = 15 mg a.i./kg-diet	Technical	44233401	Acceptable	Based on reduced eggshell thickness, eggs laid, and number of viable embryos
Mammals (Acute)					
Laboratory rat (*Rattus norvegicus*)	LD_{50} = 56 mg a.i./kg-bw	Technical	0005467	Acceptable	
Mammals (Chronic)					
Laboratory rat (*Rattus norvegicus*)	NOAEC = 20 mg a.i./kg-diet LOAEC = 80 mg a.i./kg-diet	Technical	42483901	Acceptable	Based on reduced fertility and pup weight
Terrestrial Invertebrates					
Honey bee (*Apis mellifera*)	LD_{50} = 0.5 µg a.i./bee (contact)	Technical	00036935	Acceptable	
Freshwater Invertebrates (Acute)					
Water flea (*Daphnia pulex*)	EC_{50} = 0.066 µg a.i./L	Technical	40098001	Acceptable	
Freshwater Invertebrates (Chronic)					
Water flea (*Daphnia magna*)	NOAEC = 0.0058 µg a.i./L LOAEC = 0.0122 µg a.i./L	Technical	43890301	Acceptable	Based on reduced egg production and growth (length and weight)
Freshwater Fish (Acute)					
Cutthroat trout (*Oncorhynchus clarki*)	LC_{50} = 170 µg a.i./L	Technical	40098001	Acceptable	
Freshwater Fish (Chronic)					

TAXON	ENDPOINT	FORMULATION	MRID	STUDY CLASS-IFICATION	COMMENTS
Rainbow trout (*Oncorhynchus mykiss*)	NOAEC = 5.2 µg a.i./L LOAEC = 10.1 µg a.i./L	Technical	43788001	Acceptable	Based on decreased post-hatch larval survival
Estuarine/Marine Invertebrates (Acute)					
Mysid (*Americamysis bahia*)	EC_{50} = 19.1 µg a.i./L	Technical	43571408	Acceptable	
Estuarine/Marine Invertebrates (Chronic)					
Mysid (*Americamysis bahia*)	NOAEC = 1.48 µg a.i./L LOAEC = 3.25 µg a.i./L	Technical	43854301	Acceptable	Based on reduced growth (weight and length)
Estuarine/Marine Fish (Acute)					
Sheepshead minnow (*Cyprinodon variegates*)	LC_{50} = 7,350 µg a.i./L	Technical	43571403	Acceptable	
Estuarine/Marine Fish (Chronic)					
Sheepshead minnow (*Cyprinodon variegates*)	NOAEC = 960 µg a.i./L LOAEC = 1840 µg a.i./L	Technical	43790401	Acceptable	Based on reduced survival and length

Appendix B. The Risk Quotient Method and Levels of Concern

The Risk Quotient Method is the means used by EFED to integrate the results of exposure and ecotoxicity data. For this method, Risk Quotients (RQs) are calculated by dividing exposure estimates by the acute and chronic ecotoxicity values (i.e., RQ = EXPOSURE/TOXICITY). These RQs are then compared to OPP's levels of concern (LOCs). These LOCs are criteria used by OPP to indicate potential risk to non-target organisms and the need to consider regulatory action. EFED has defined LOCs for acute risk, potential restricted use classification, and for endangered species.

The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on non-target organisms. LOCs currently address the following risk presumption categories:

(1) acute - there is a potential for acute risk; regulatory action may be warranted in addition to restricted use classification;

(2) acute restricted use - the potential for acute risk is high, but this may be mitigated through restricted use classification;

(3) acute endangered species - the potential for acute risk to endangered species is high, regulatory action may be warranted; and

(4) chronic risk - the potential for chronic risk is high, regulatory action may be warranted.

Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to non-target insects, or chronic risk from granular/bait formulations to mammalian or avian species.

The ecotoxicity test values (i.e., measurement endpoints) used in the acute and chronic RQs are derived from required studies. Examples of ecotoxicity values derived from short-term laboratory studies that assess acute effects are: (1) LC50 (fish and birds), (2) LD50 (birds and mammals), (3) EC50 (aquatic plants and aquatic invertebrates), and (4) EC25 (terrestrial plants). Examples of toxicity test effect levels derived from the results of long-term laboratory studies that assess chronic effects are: (1) the Lowest Observed Adverse Effect Concentration (LOAEC) (birds, fish, and aquatic invertebrates), and (2) the No Observed Adverse Effect Concentration (NOAEC) (birds, fish and aquatic invertebrates). The NOAEC is generally used as the ecotoxicity test value in assessing chronic effects. Risk presumptions, along with the corresponding RQs and LOCs are summarized in Table B1.

Table B1. Agency risk quotient (RQ) metrics and levels of concern (LOC) per risk class.			
Risk Class	**Risk Description**	**RQ**	**LOC**
Aquatic Animals (fish and invertebrates)			
Acute	Potential for effects to non-listed animals from acute exposures	Peak EEC/LC_{50}[1]	0.5
Acute Restricted Use	Potential for effects to animals from acute exposures Risks may be mitigated through restricted use classification	Peak EEC/LC_{50}[1]	0.1
Acute Listed Species	Listed species may be potentially affected by acute exposures	Peak EEC/LC_{50}[1]	0.05
Chronic	Potential for effects to non-listed and listed animals from chronic exposures	60-day EEC/NOEC (fish) 21-day EEC/NOEC (invertebrates)	1
Terrestrial Animals (mammals and birds)			
Acute	Potential for effects to non-listed animals from acute exposures	EEC^2/LC_{50} (Dietary) EEC/LD_{50} (Dose)	0.5
Acute Restricted Use	Potential for effects to animals from acute exposures Risks may be mitigated through restricted use classification	EEC^2/LC_{50} (Dietary) EEC/LD_{50} (Dose)	0.2
Acute Listed Species	Listed species may be potentially affected by acute exposures	EEC [2]/LC_{50} (Dietary) EEC/LD_{50} (Dose)	0.1
Chronic	Potential for effects to non-listed and listed animals from chronic exposures	EEC [2]/NOAEC	1
Plants			
Non-Listed	Potential for effects to non-target, non-listed plants from exposures	EEC/ EC_{25}	1
Listed Plant	Potential for effects to non-target, listed plants from exposures	EEC/ NOEC EEC/ EC_{05}	1

[1] LC_{50} or EC_{50}. [2] Based on upper bound Kenaga values.

Appendix C. Data Call-In Tables

The Environmental Fate and Effects Division (EFED) has completed a Data Call-In (DCI) table for the trichlorfon (and DDVP) environmental fate and effects data gaps identified in registration review. The effects data gaps may change if relevant toxicity data are identified from the ECOTOX literature review. The attached DCI tables, which include the guideline number and study title for required data, also provides a rationale for requiring the data, an explanation of how the data will be used, and a brief description of how the data could impact the Agency's future decision-making.

Trichlorfon:

Guideline Number: 835.2120 **Study Title: Hydrolysis**
Rationale for Requiring the Data
Acceptable data have not been provided to quantify the hydrolysis of trichlorfon. According to Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart D (data requirements for pesticides) hydrolysis data are required for pesticides with terrestrial or aquatic uses. Since trichlorfon uses are classified as terrestrial and aquatic, hydrolysis data for trichlorfon should be submitted to fulfill OPPTS Guideline 835.2120.
Practical Utility of the Data
How will the data be used? These data are used to estimate the degradation of trichlorfon in aquatic systems and ultimately to derive aquatic EECs using PRZM/EXAMS. **How could the data impact the Agency's future decision-making?** In the case that these data are unavailable at the time risk assessments are conducted, it will be assumed that trichlorfon is stable to hydrolysis. If trichlorfon does degrade due to hydrolysis, this assumption will result in overestimates of the concentrations of trichlorfon in the environment.

Guideline Number: 835.2410 **Study Title: Photodegradation in soil**
Rationale for Requiring the Data
Acceptable data have not been provided to quantify the photolysis of trichlorfon in water. According to Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart D (data requirements for pesticides) aqueous photolysis data are required for pesticides with terrestrial or aquatic uses. Since trichlorfon uses are classified as terrestrial and aquatic, aqueous photolysis data for trichlorfon should be submitted to fulfill OPPTS Guideline 835.2410.
Practical Utility of the Data
How will the data be used? These data are used to characterize the degradation of trichlorfon in soil. **How could the data impact the Agency's future decision-making?** In the case that these data are not submitted, it will be assumed that trichlorfon is stable to photolysis on soil.

Guideline Number: 835.4300 **Study Title: Aerobic Aquatic Metabolism**
Rationale for Requiring the Data
Acceptable data have not been provided to quantify the metabolism of trichlorfon under aerobic aquatic conditions. According to Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart D (data requirements for pesticides) aerobic aquatic metabolism are required for pesticides with terrestrial or aquatic uses. Since trichlorfon uses are classified as terrestrial and aquatic, aerobic aquatic metabolism data for trichlorfon should be submitted to fulfill OPPTS Guideline 835.4300.
Practical Utility of the Data
How will the data be used? These data are used to estimate the degradation of trichlorfon in aquatic systems and ultimately to derive aquatic EECs using PRZM/EXAMS. **How could the data impact the Agency's future decision-making?** In the case that these data are unavailable at the time risk assessments are conducted, PRZM/EXAMS input parameter guidance default values will be employed to account for aerobic aquatic metabolism.

Guideline Number: 835.4400 **Study Title: Anaerobic Aquatic Metabolism**
Rationale for Requiring the Data
Acceptable data have not been provided to quantify the metabolism of trichlorfon under anaerobic aquatic conditions. According to Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart D (data requirements for pesticides) anaerobic aquatic metabolism data are required for pesticides with terrestrial or aquatic uses. Since trichlorfon uses are classified as terrestrial and aquatic, anaerobic aquatic metabolism data for trichlorfon should be submitted to fulfill OPPTS Guideline 835.4400.
Practical Utility of the Data
How will the data be used? These data are used to estimate the degradation of trichlorfon in aquatic systems and ultimately to derive aquatic EECs using PRZM/EXAMS. **How could the data impact the Agency's future decision-making?** In the case that these data are unavailable at the time risk assessments are conducted, PRZM/EXAMS input parameter guidance default values will be employed to account for anaerobic aquatic metabolism.

Guideline Number: 835.1240 **Study Title: adsorption/desorption**
Rationale for Requiring the Data
Acceptable data have not been provided to quantify the adsorption/desorption characteristics of trichlorfon in U.S. soils. According to Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart D (data requirements for pesticides) adsorption/desorption data are required for pesticides with terrestrial uses. Since trichlorfon uses are considered to be terrestrial, an acceptable study should be submitted to fulfill OPPTS Guideline 835.1240. This study should define K_d and K_{OC} values of trichlorfon in U.S. soils. It is preferred that this study be conducted using a batch equilibrium method.
Practical Utility of the Data

How will the data be used?
These data are used to estimate the transport of trichlorfon from treatment sites to aquatic systems and ultimately to derive aquatic EECs using PRZM/EXAMS.

How could the data impact the Agency's future decision-making?
In the absence of these data, EFED will assume that there is no sorption of trichlorfon to soils or organic matter on the treatment site. In order to implement this in derivation of aquatic EECs, a K_{OC} value of 0 will be used to parameterize PRZM/EXAMS. Input of a K_{OC} value >0 is expected to result in lower aquatic EECs. If acceptable data are provided, the uncertainties associated with this assumption will be reduced.

Guideline Number: 835.6200
Study Title: Aquatic Field Dissipation

Rationale for Requiring the Data

At this time, no acceptable studies are available to describe the dissipation of trichlorfon under aquatic field conditions. According to Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart D (data requirements for pesticides), aquatic field dissipation data are required for pesticides with aquatic uses. Since trichlorfon uses are classified as aquatic, aquatic field dissipation data for trichlorfon should be submitted to fulfill OPPTS Guideline 835.6200.

Practical Utility of the Data

How will the data be used?
These data are used to characterize the fate of trichlorfon in the aquatic environment resulting from direct applications to water.

How could the data impact the Agency's future decision-making?
These data are useful to validate laboratory fate data of trichlorfon with a field study that accounts for all of the fate processes studied under laboratory conditions (e.g., hydrolysis, photolysis).

Guideline Number: 835.6100 (7), 835.6200 (7)
Study Title: Environmental Chemistry Methods

Rationale for Requiring the Data

Independently validated analytical methods for residues in soil and water (environmental chemistry methods) submitted by the registrant are used to evaluate analyses described in submitted environmental fate and ecological effects studies. Submitted analytical methods are also used by various Federal, State, Tribal, and local agencies to detect and monitor residues that are or are suspected to be in environmental compartments due to outdoor uses and accidental releases. Therefore, availability of these analytical methods is necessary in order to protect human health and the environment from trichlorfon residues in the environment. Independent laboratory validations for submitted analytical methods are necessary to confirm the levels of detection and quantitation reported in registrant-prepared validations.

Use of trichlorfon may impact surface water quality due to runoff of rain water and drift of residues. Therefore, analytical methods for are necessary for detecting trichlorfon residues in water and in soil or sediment.

Practical Utility of the Data

How will the data be used?
In the absence of independently validated environmental chemistry methods, submitted environmental fate and ecological effects data may not be reviewable and entities outside the Agency may lack chemical-specific methods for analyses in environmental compartments. Independently validated environmental chemistry methods will be used to evaluate the submitted environmental fate and ecological effects data and will be made available to the public to support monitoring for trichlorfon residues.

How could the data change the Agency's decision, or impact the Agency's future decision-making?
Risk assessment conclusions could be altered if they are not supported by either study data or environmental monitoring detections that are based on independently validated environmental chemistry methods. Furthermore, while not directly related to Agency decision-making, independently validated environmental chemistry methods are necessary in order to protect human health and the environment from use of trichlorfon.

Guideline Number: 850.2100
Study Title: Avian Acute Oral Toxicity Test (mallard duck or bobwhite quail and a passerine species)

Rationale for Requiring the Data

No acceptable acute avian oral toxicity data were submitted for trichlorfon. The new Part 158 data requirements [40 CFR Part 158 (CFR 40 2007)] specify that acute avian oral toxicity data be submitted for either mallard duck or bobwhite quail and a passerine species. The available chronic toxicity data for mallard ducks and bobwhite quails demonstrate that trichlorfon can cause toxic effects in these birds. In addition, avian data for other organophosphate (OP) insecticides, including dimethoate, show that a passerine species, such as the red-winged blackbird, are one order of magnitude more sensitive than other tested bird species to acute OP insecticide exposure (USEPA 2008). Therefore, an avian oral toxicity test is required for passerine birds and either the mallard duck or the bobwhite quail, as specified in 40 CFR Part 158. A passerine study protocol must be submitted for review by the Agency prior to initiation of this study.

Practical Utility of the Data

How will the data be used?
Acute avian oral toxicity data will be used to identify potential risks to birds from acute exposure to trichlorfon. The data will reduce uncertainties associated with the current risk assessment for birds and will improve the Agency's understanding of the potential effects of trichlorfon on terrestrial species. If oral acute toxicity data are not submitted for any bird, than risk to birds from acute exposure to trichlorfon will be assumed.

How could the data impact the Agency's future decision-making?
If future endangered species risk assessments are performed without these data, the Agency would have to assume that trichlorfon "may affect" listed birds directly (and listed species from other taxa indirectly), and use of trichlorfon and its formulated products may need to be restricted in areas where listed species could be exposed. The lack of these data will limit the flexibility the Agency and registrants have in coming into compliance with the Endangered Species Act and could result in use restrictions for trichlorfon use that are unnecessarily severe.

Guideline Number: 850.2200
Study Title: Avian Dietary Toxicity Test (mallard duck and bobwhite quail)

Rationale for Requiring the Data

No acceptable sub-acute avian dietary toxicity data were submitted for trichlorfon. The new Part

158 data requirements [40 CFR Part 158 (CFR 40 2007)] specify that avian dietary toxicity data be submitted for both a waterfowl and upland game species. The available chronic toxicity data for mallard ducks and bobwhite quails demonstrate that trichlorfon can cause toxic effects in these birds. Therefore, an avian dietary toxicity test is required for mallard ducks and bobwhite quails as specified in 40 CFR Part 158.

Practical Utility of the Data

How will the data be used?
Sub-acute avian dietary toxicity data will be used to identify potential risks to birds from acute exposure to trichlorfon. The data will reduce uncertainties associated with the current risk assessment for birds and will improve the Agency's understanding of the potential effects of trichlorfon on terrestrial species. If dietary toxicity data are not submitted for any bird, than risk to birds from dietary exposure to trichlorfon will be assumed.

How could the data impact the Agency's future decision-making?
If future endangered species risk assessments are performed without these data, the Agency would have to assume that trichlorfon "may affect" listed birds directly (and listed species from other taxa indirectly), and use of trichlorfon and its formulated products may need to be restricted in areas where listed species could be exposed. The lack of these data will limit the flexibility the Agency and registrants have in coming into compliance with the Endangered Species Act and could result in use restrictions for trichlorfon use that are unnecessarily severe.

Guideline Number: 850.1075
Study Title: Fish Acute Toxicity Test, Estuarine/Marine

Rationale for Requiring the Data

Acute toxicity data are not available for estuarine and marine fish. The updated Part 158 data requirements, published in October 2007, specify that acute toxicity data are required on one estuarine/marine mollusk (guideline fulfilled), one estuarine/marine invertebrate (guideline not fulfilled), and one estuarine/marine fish (guideline not fulfilled) for terrestrial (food crop, feed crop, and nonfood), aquatic food crop, and nonfood (outdoor), forestry, and residential outdoor uses. Trichlorfon has terrestrial (turf), aquatic nonfood (ornamental/bait ponds) and residential outdoor uses registered, and therefore, the acute estuarine/marine organism toxicity studies are required.

In the absence of these data, an acute-to-chronic ratio (ACR) would normally be derived; and the acute toxicity to estuarine and marine fish would be estimated based on the ACR for freshwater fish. However, there are currently no toxicity data (acute or chronic) for estuarine/marine fish, therefore, an ACR cannot be derived. In addition, three of the four reported ecological incidents associated with the use of trichlorfon have involved fish kills.

Practical Utility of the Data

How will the data be used?
Estuarine/marine fish acute toxicity data will be used to determine the potential for trichlorfon to affect fish species in estuarine/marine environments. The data will reduce uncertainties associated with the current risk assessment for estuarine/marine fish and will improve the Agency's understanding of the potential effects of trichlorfon on aquatic animals. In the absence of data specific for these fish, data from freshwater fish species will be used as a surrogate for estuarine/marine fish.

How could the data impact the Agency's future decision-making?
Using toxicity data from a freshwater species as a surrogate for estuarine/marine species increases the uncertainty for assessing risks to estuarine/marine species in screening-level assessments.

Additionally, if future endangered species risk assessments are performed without these data, the Agency would have to presume risk to listed estuarine/marine fish species in the absence of such data for trichlorfon. Therefore, the use of trichlorfon and its formulated products may need to be restricted in areas where listed species could be exposed. The lack of these data will limit the flexibility the Agency and registrants have in coming into compliance with the Endangered Species Act and could result in use restrictions for trichlorfon that are unnecessarily severe.

Guideline Number: 850.1035
Study Title: Mysid Acute Toxicity Test

Rationale for Requiring the Data

Although, acute toxicity data are available for an estuarine/marine mollusk, no acute data are currently available for a non-mollusk estuarine/marine invertebrate. The updated Part 158 data requirements, published in October 2007, specify that acute toxicity data are required on one estuarine/marine mollusk (guideline fulfilled), one estuarine/marine invertebrate (guideline not fulfilled), and one estuarine/marine fish (guideline not fulfilled) for terrestrial (food crop, feed crop, and nonfood), aquatic food crop, and nonfood (outdoor), forestry, and residential outdoor uses. Trichlorfon has terrestrial (turf), aquatic nonfood (ornamental/bait ponds) and residential outdoor uses registered, and therefore, the acute estuarine/marine organism toxicity studies are required.

In the absence of these data, an acute-to-chronic ratio (ACR) would normally be derived; and the acute toxicity to estuarine/marine invertebrates would be estimated based on the ACR for freshwater invertebrates. However, the freshwater invertebrate data necessary for calculating the ACR are not available. Chronic data are not available for the most acutely sensitive freshwater species (*Pteronarcella badia*).

Practical Utility of the Data

How will the data be used?
Estuarine/marine invertebrate acute toxicity data will be used to determine the potential for trichlorfon to affect non-mollusk invertebrate species in estuarine/marine environments. The data will reduce uncertainties associated with the current risk assessment for estuarine/marine invertebrates and will improve the Agency's understanding of the potential effects of trichlorfon on aquatic animals. In the absence of data specific for these invertebrates, data from freshwater invertebrate species will be used as a surrogate for estuarine/marine invertebrates.

How could the data impact the Agency's future decision-making?
Using toxicity data from a freshwater species as a surrogate for estuarine/marine species increases the uncertainty for assessing risks to estuarine/marine species in screening-level assessments. Additionally, if future endangered species risk assessments are performed without these data, the Agency would have to presume risk to listed non-mollusk estuarine/marine invertebrate species in the absence of such data for trichlorfon. Therefore, the use of trichlorfon and its formulated products may need to be restricted in areas where listed species could be exposed. The lack of these data will limit the flexibility the Agency and registrants have in coming into compliance with the Endangered Species Act and could result in use restrictions for trichlorfon that are unnecessarily severe.

Guideline Number: 850.1400
Study Title: Fish Early Life-Stage Toxicity Test, Estuarine/Marine

Rationale for Requiring the Data

Chronic toxicity data are not available for estuarine and marine fish. In the absence of these data, an acute-to-chronic ratio (ACR) would normally be derived; and the chronic toxicity to estuarine

and marine fish would be estimated based on the ACR for freshwater fish. However, there are currently no toxicity data (acute or chronic) for estuarine/marine fish, therefore, an ACR cannot be derived. Additionally, due to the potential use pattern of trichlorfon , exposure to estuarine/marine environments is possible. Therefore, an early life-stage toxicity study is required for estuarine/marine fish, as specified in 40 CFR Part 158.

Practical Utility of the Data

How will the data be used?
Estuarine/marine fish chronic toxicity data will be used to determine the potential for trichlorfon to affect fish species in estuarine/marine environments. The data will reduce uncertainties associated with the current risk assessment for estuarine/marine fish and will improve the Agency's understanding of the potential effects of trichlorfon on aquatic animals. In the absence of data specific for these fish, data from freshwater fish species will be used as a surrogate for estuarine/marine fish.

How could the data impact the Agency's future decision-making?
Using toxicity data from a freshwater species as a surrogate for estuarine/marine species increases the uncertainty for assessing risks to estuarine/marine species in screening-level assessments. Additionally, if future endangered species risk assessments are performed without these data, the Agency would have to presume risk to listed estuarine/marine fish species in the absence of such data for trichlorfon. Therefore, the use of trichlorfon and its formulated products may need to be restricted in areas where listed species could be exposed. The lack of these data will limit the flexibility the Agency and registrants have in coming into compliance with the Endangered Species Act and could result in use restrictions for trichlorfon that are unnecessarily severe.

Guideline Number: 850.4100, 850.4150
Study Title: Terrestrial Plant Toxicity Test, Tier I (Seedling Emergence and Vegetative Vigor)

Rationale for Requiring the Data

Toxicity data for terrestrial plants are not available for trichlorfon. The current 40 CFR Part 158 data requirements, require Tier I level seedling emergence and vegetative vigor terrestrial plant data for all insecticides. Additionally, other OPs are known to be phytotoxic (*e.g*., tribufos, a plant defoliant). Therefore, Tier I plant toxicity studies (seedling emergence and vegetative vigor) are required for terrestrial plants, as specified in 40 CFR Part 158.

Practical Utility of the Data

How will the data be used?
Vegetative vigor and seedling emergence data for terrestrial plants will be used to determine the potential for trichlorfon to affect non-target plant species in the terrestrial environment. The data will reduce uncertainties associated with the current risk assessment for terrestrial plants and will improve the Agency's understanding of the potential effects of trichlorfon on terrestrial plants. In the absence of data specific for these plants, risk to terrestrial plants will be assumed.

How could the data impact the Agency's future decision-making?
Because terrestrial plants form the basis of the food chain in many terrestrial habitats, a solid understanding of the potential risks to terrestrial plants is essential for sound environmental risk management decision-making. Without terrestrial plant data for trichlorfon, the Agency cannot determine if the current application rates for trichlorfon may result in direct adverse effects to terrestrial plants and/or indirect effects resulting from reduction in the prey base and/or loss of habitat/cover. If future endangered species risk assessments are performed without these data, the Agency would have to presume risk to non-target terrestrial plants from use of trichlorfon. Therefore, use of trichlorfon and its formulated products may need to be restricted in areas where

listed species could be exposed. The lack of these data will limit the flexibility the Agency and registrants have in coming into compliance with the Endangered Species Act and could result in use restrictions for trichlorfon that are unnecessarily severe.

Guideline Number: 850.4400 **Study Title: Aquatic plant toxicity (Tier I)**
Rationale for Requiring the Data
Trichlorfon toxicity data for vascular and non-vascular aquatic plants are not available. Based on the 40 CFR Part 158 data requirements, Tier I level non-target aquatic plant data are required for all insecticides. Additionally, other OPs are known to be phyotoxic (*e.g.*, tribufos, which is a defoliant). Therefore, non-target aquatic plant data for algae and vascular plants are required for trichlorfon at the Tier I level.
Practical Utility of the Data
How will the data be used? Data from Tier I aquatic plant toxicity studies will be used to estimate potential risks to aquatic vascular and non-vascular plants associated with the use of trichlorfon. The data will reduce uncertainties associated with the current risk assessment for aquatic plants and will improve the Agency's understanding of the potential effects of trichlorfon on aquatic plants. In the absence of Tier I data, risks for both vascular and non-vascular aquatic plants will be presumed. **How could the data impact the Agency's future decision-making?** Because aquatic vascular and non-vascular plants form the basis of the food chain for aquatic habitats and significantly contribute to overall water quality, a solid understanding of the potential risks to aquatic plants is essential for sound environmental risk management decision-making. Without aquatic plant data for trichlorfon, the Agency cannot determine if the current application rates for trichlorfon may result in direct adverse effects to aquatic plants and/or indirect effects resulting from reduction in the prey base and/or loss of habitat/cover. If future endangered species risk assessments are performed without these data, the Agency would have to assume that trichlorfon "may affect" aquatic plants directly (and listed species from other taxa indirectly via reduction in prey base and/or habitat), and use of trichlorfon may need to be restricted in areas where listed species could be exposed. The lack of these data will limit the flexibility the Agency and registrants have in coming into compliance with the Endangered Species Act and could result in use restrictions for trichlorfon which are unnecessarily severe.

DDVP:

Guideline Number: 850.2100 **Study Title: Avian Acute Oral Toxicity Test**
Rationale for Requiring the Data
Acceptable acute avian oral toxicity data were submitted for exposures of bobwhite quail to DDVP; however, data are not available for passerines, which are required under the new 40 CFR Part 158 (CFR 40 2007) data requirements for conventional pesticides (72 FR 60934; USEPA 2007*c*). The available data for bobwhite quails show that DDVP is classified as very highly toxic to birds on an acute exposure. In addition, avian data for other organophosphate (OP) insecticides, including dimethoate, show that a passerine species, such as the red-winged blackbird, are one order of magnitude more sensitive than other tested bird species to acute OP insecticide exposure. Therefore, an avian oral toxicity test is required for passerine birds, as specified in 40 CFR Part 158. A passerine study protocol must be submitted for review by the Agency prior to initiation of this study.
Practical Utility of the Data

How will the data be used?
Acute avian oral toxicity data will be used to identify potential risks to birds from acute exposure to DDVP from the use of trichlorfon. The data will reduce uncertainties associated with the current risk assessment for birds and will improve the Agency's understanding of the potential effects of trichlorfon on terrestrial species. If oral acute toxicity data are not submitted for passerines, than risk to passerines from acute exposure to DDVP from the use of trichlorfon will be assumed.

How could the data impact the Agency's future decision-making?
If future endangered species risk assessments are performed without these data, the Agency would have to assume that trichlorfon "may affect" listed passerine species directly (and listed species from other taxa indirectly), and use of trichlorfon and its formulated products may need to be restricted in areas where listed species could be exposed. The lack of these data will limit the flexibility the Agency and registrants have in coming into compliance with the Endangered Species Act and could result in use restrictions for trichlorfon use that are unnecessarily severe.

Guideline Number: 850.4100, 850.4150
Study Title: Terrestrial Plant Toxicity Test, Tier I (Seedling Emergence and Vegetative Vigor)

Rationale for Requiring the Data

Toxicity data for terrestrial plants are not available for DDVP. The current 40 CFR Part 158 data requirements, require Tier I level seedling emergence and vegetative vigor terrestrial plant data for all insecticides. Additionally, other OPs are known to be phytotoxic (*e.g.*, tribufos, a plant defoliant). Therefore, Tier I plant toxicity studies (seedling emergence and vegetative vigor) are required for terrestrial plants, as specified in 40 CFR Part 158.

Practical Utility of the Data

How will the data be used?
Vegetative vigor and seedling emergence data for terrestrial plants will be used to determine the potential for DDVP (from the use of trichlorfon) to affect non-target plant species in the terrestrial environment. The data will reduce uncertainties associated with the current risk assessment for terrestrial plants and will improve the Agency's understanding of the potential effects of trichlorfon on terrestrial plants. In the absence of data specific for these plants, risk to terrestrial plants will be assumed.

How could the data impact the Agency's future decision-making?
Because terrestrial plants form the basis of the food chain in many terrestrial habitats, a solid understanding of the potential risks to terrestrial plants is essential for sound environmental risk management decision-making. Without terrestrial plant data for DDVP, the Agency cannot determine if the current application rates for trichlorfon may result in direct adverse effects to terrestrial plants and/or indirect effects resulting from reduction in the prey base and/or loss of habitat/cover. If future endangered species risk assessments are performed without these data, the Agency would have to presume risk to non-target terrestrial plants from use of trichlorfon. Therefore, use of trichlorfon and its formulated products may need to be restricted in areas where listed species could be exposed. The lack of these data will limit the flexibility the Agency and registrants have in coming into compliance with the Endangered Species Act and could result in use restrictions for trichlorfon that are unnecessarily severe.

Guideline Number: 850.4400
Study Title: Aquatic plant toxicity (Tier I)

Rationale for Requiring the Data

DDVP toxicity data for vascular and non-vascular aquatic plants are not available. Based on the 40

CFR Part 158 data requirements, Tier I level non-target aquatic plant data are required for all insecticides. Additionally, other OPs are known to be phyotoxic (*e.g.*, tribufos, which is a defoliant). Therefore, non-target aquatic plant data for algae and vascular plants are required for DDVP at the Tier I level.

Practical Utility of the Data

How will the data be used?

Data from Tier I aquatic plant toxicity studies will be used to estimate potential risks to aquatic vascular and non-vascular plants from DDVP exposure associated with the use of trichlorfon. The data will reduce uncertainties associated with the current risk assessment for aquatic plants and will improve the Agency's understanding of the potential effects of trichlorfon on aquatic plants. In the absence of Tier I data, risks for both vascular and non-vascular aquatic plants will be presumed.

How could the data impact the Agency's future decision-making?

Because aquatic vascular and non-vascular plants form the basis of the food chain for aquatic habitats and significantly contribute to overall water quality, a solid understanding of the potential risks to aquatic plants is essential for sound environmental risk management decision-making. Without aquatic plant data for DDVP, the Agency cannot determine if the current application rates for trichlorfon may result in direct adverse effects to aquatic plants and/or indirect effects resulting from reduction in the prey base and/or loss of habitat/cover. If future endangered species risk assessments are performed without these data, the Agency would have to assume that trichlorfon "may affect" aquatic plants directly (and listed species from other taxa indirectly via reduction in prey base and/or habitat), and use of trichlorfon may need to be restricted in areas where listed species could be exposed. The lack of these data will limit the flexibility the Agency and registrants have in coming into compliance with the Endangered Species Act and could result in use restrictions for trichlorfon which are unnecessarily severe.